

# **ICESat (GLAS) Science Processing Software Document Series**

## **Volume # GSAS Version Description Version 4.0**

**Jeffrey Lee/Raytheon ITSS  
Observational Science Branch  
Laboratory for Hydrospheric Processes  
NASA/GSFC Wallops Flight Facility  
Wallops Island, Virginia 23337**

**August 2004**

### **ICESat Contacts:**

**H. Jay Zwally, ICESat Project Scientist  
*NASA Goddard Space Flight Center  
Greenbelt, Maryland 20771***

**Bob E. Schutz, GLAS Science Team Leader  
*University of Texas Center for Space Research  
Austin, Texas 78759-5321***

**David W. Hancock III, Science Software Development Leader  
*NASA/GSFC Wallops Flight Facility  
Wallops Island, Virginia 23337***





# Foreword

This document contains the GLAS Science Algorithm Software (GSAS) Version Description document. This document is developed under the structure of the NASA STD-2100-91, a NASA standard defining a four-volume set of documents to cover an entire software life cycle. Under this standard a section of any volume may, if necessary, be rolled out to its own separate document. This document is a roll-out of the version description within the Product Specification Volume.

The GEOSCIENCE LASER ALTIMETER SYSTEM (GLAS) is a part of the EOS program. This laser altimetry mission will be carried on the spacecraft designated EOS ICESat (Ice, Cloud and Land Elevation Satellite). The GLAS laser is a frequency-doubled, cavity-pumped, solid state Nd:YAG laser.

This document was prepared by the Observational Science Branch at NASA GSFC/WFF, Wallops Island, VA, in support of B. E. Schutz, GLAS Science Team Leader for the GLAS Investigation. This work was performed under the direction of David W. Hancock, III, who may be contacted at (757) 824-1238, David.W.Hancock@nasa.gov (e-mail), or (757) 824-1036 (FAX).

This document was created through the efforts of the GLAS Science Software Development Team. Current team members include:

Raytheon/Kristine Barbieri

Raytheon/Suneel Bhardwaj

Raytheon/Lisa Brittingham

Raytheon/John Dimarzio

972/David W. Hancock, III

Raytheon/Peggy Jester

Raytheon/Jeffrey Lee

Raytheon/Dennis Lockwood

Raytheon/Steve McLaughlin

SSAI/Steve Palm

Raytheon/Carol Purdy

Raytheon/Lee Anne Roberts

Raytheon/Jack Saba



# Table of Contents

Foreword .....	iii
Table of Contents .....	v
List of Figures .....	vii
List of Tables .....	ix
<b>Section 1</b>	<b>Introduction</b>
1.1	Identification of Document ..... 1-1
1.2	Scope of Document ..... 1-1
1.3	Purpose and Objectives of Document. .... 1-1
1.4	Document Organization ..... 1-1
1.5	Document Change History ..... 1-2
<b>Section 2</b>	<b>Related Documentation</b>
2.1	Parent Documents. .... 2-1
2.2	Applicable Documents. .... 2-1
2.3	Information Documents ..... 2-1
<b>Section 3</b>	<b>Product Description</b>
3.1	Purpose ..... 3-1
3.2	Environment ..... 3-1
3.3	Functions ..... 3-1
3.4	Restrictions and Limitations ..... 3-2
<b>Section 4</b>	<b>Inventory and Product</b>
4.1	Materials Released ..... 4-1
4.2	Product Content ..... 4-1
<b>Section 5</b>	<b>Change Status</b>
5.1	Installed Changes ..... 5-1
5.2	Possible Problems and Known Errors ..... 5-4
5.3	Requirements Not Supported in the V4 Delivery ..... 5-6
5.4	Change Notes. .... 5-6
Abbreviations & Acronyms .....	AB-1
Glossary .....	GL-1



# List of Figures

Figure 1-1	I-SIPS Software Top-Level Decomposition.....	1-2
------------	--	-----





## List of Tables

Table 4-1	Top-level Content .....	4-1
Table 4-2	data Content. ....	4-2
Table 4-3	docs Content .....	4-2
Table 4-4	GSAS Content .....	4-3
Table 4-6	data Content. ....	4-4
Table 4-5	cc_util Content. ....	4-4
Table 4-7	src Content .....	4-5
Table 5-1	ATBD Versions Implemented in V4.0 .....	5-1
Table 5-2	PR/CRs Addressed in Version 4.0 .....	5-3
Table 5-3	Open or Suspended PR/CRs for Version 4.0 .....	5-4
Table 5-4	Requirements Not Supported .....	5-6



## Section 1

# Introduction

### 1.1 Identification of Document

This is the Version Description document for the Version 4.0 delivery of the GLAS Science Algorithm Software (GSAS). The unique document identification number within the GLAS Ground Data System numbering scheme is TBD. Successive editions of this document will be uniquely identified by the cover and page date marks.

### 1.2 Scope of Document

The GLAS I-SIPS Data Processing System, shown in Figure 1-1, provides data processing and mission support for the Geoscience Laser Altimeter System (GLAS). I-SIPS is composed of two major software components - the GLAS Science Algorithm Software (GSAS) and the Scheduling and Data Management System (SDMS). GSAS processes raw satellite data and creates EOS Level 1A/B and 2 data products. SDMS provides for scheduling of processing and the ingest, staging, archiving and cataloging of associated data files. This document is the Version Description for the GSAS Version 4 software delivery.

### 1.3 Purpose and Objectives of Document

The purpose of this document is to provide a precise description of the Version 4.0 delivery of GSAS.

### 1.4 Document Organization

This document's outline is assembled in a form similar to those presented in the NASA Software Engineering Program [Information Document 2.3a].

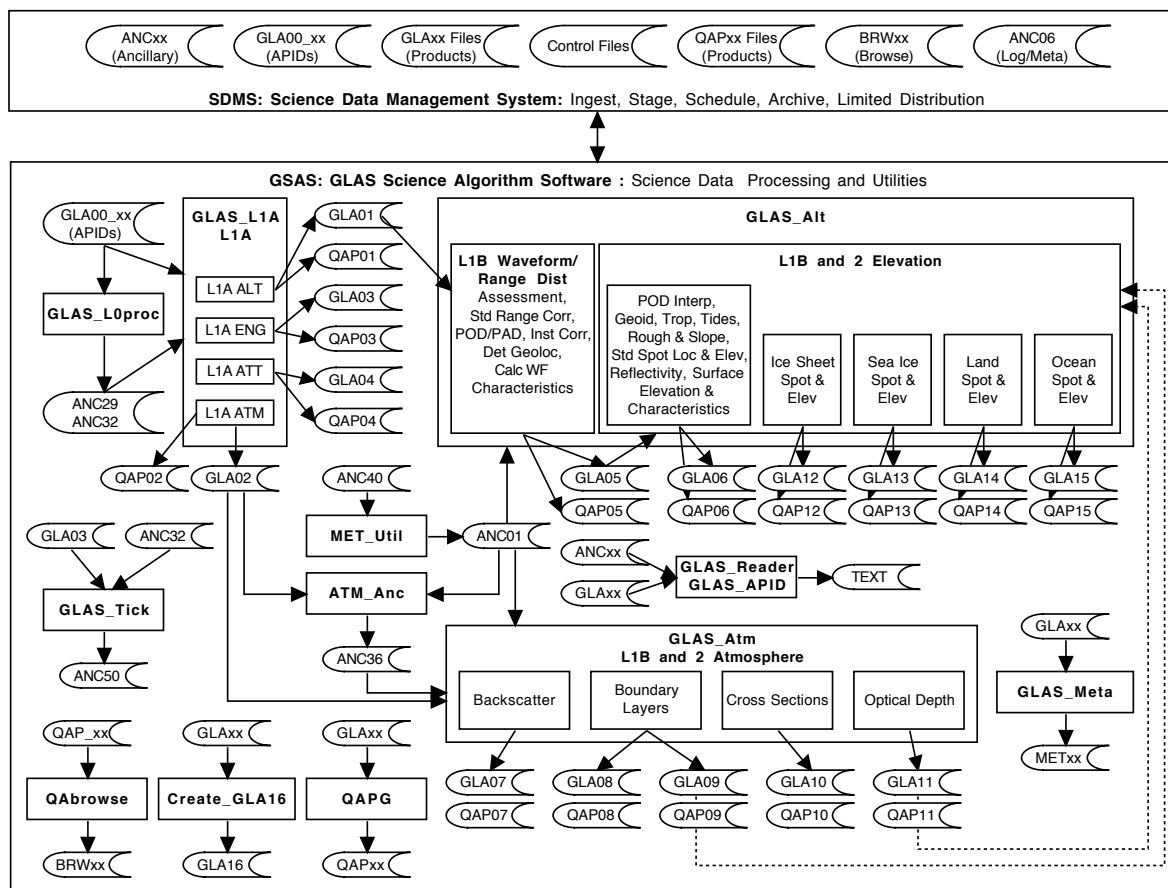


Figure 1-1 I-SIPS Software Top-Level Decomposition

## 1.5 Document Change History

Document Name: GLAS Science Algorithm Software Version Description		
Version Number	Date	Nature of Change
Version 0	July 1999	Original Version.
Version 1	November 2000	Revised for V1 software.
Version 2	November 2001	Revised for V2 software.
Version 2.2	July 2002	Revised for V2 software.
Version 3.0	October 2002	Revised for V3 software.
Version 4.0	August 2004	Revised for V4.0 software.

## Related Documentation

### 2.1 Parent Documents

Parent documents are those external, higher-level documents that contribute information to the scope and content of this document. The following GLAS documents are parent to this document.

- a) *GLAS Science Software Management Plan (GLAS SSMP)*, NASA/TM-1999-208641/Version 3/Volume 1, August 1998, NASA/GSFC Wallops Flight Facility.

The GLAS SSMP is the top-level Volume 1 (Management Plan Volume) document of the four volumes of NASA software engineering documentation [Applicable Reference 2.2c]. It dictates the creation and maintenance of the Product Specification Volume (Volume 2). This document is a roll out of the Product Specification Volume.

### 2.2 Applicable Documents

- a) *NASA Software Documentation Standard Software Engineering Program*, NASA-STD-2100-91, July 29, 1991, NASA.
- b) *GLAS Science Algorithm Software (GSAS) Detailed Design Document*, Version 4.0, August 2004, NASA/GSFC Wallops Flight Facility.
- c) *GLAS Science Algorithm Software (GSAS) User's Guide*, Version 5.0, August 2004, NASA/GSFC Wallops Flight Facility
- d) *GLAS ISIPS Operational Procedures Manual*, TBD.

### 2.3 Information Documents

- a) *GLAS Science Telemetry Packets Definition Document*, GLAS-582-SPEC-002/Revision B, October 11, 2000, NASA Goddard Space Flight Center.
- b) *GLAS Standard Data Products Specification - Level 1*, Version 7.0, August 2004, NASA/GSFC Wallops Flight Facility.
- c) *GLAS Standard Data Products Specification - Level 2*, Version 7.0, August 2004, NASA/GSFC Wallops Flight Facility.
- d) *GLAS Science Data Management Plan (GLAS SDMP)*, NASA/TM-1999-208641/Version 4/Volume 2, July 1999, NASA/GSFC Wallops Flight Facility.
- e) *Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights*, Algorithm Theoretical Basis Document, Version 4.3, August 2004, NASA GSFC, et. al.

- f) *Precision Orbit Determination (POD)*, Algorithm Theoretical Basis Document, Version 2.2, October 2002, Center for Space Research, The University of Texas at Austin.
- g) *Precision Attitude Determination (PAD)*, Algorithm Theoretical Basis Document, Version 2.2, October 2002, Center for Space Research, The University of Texas at Austin.
- h) *Atmospheric Delay Correction to GLAS Laser Altimeter Ranges*, Algorithm Theoretical Basis Document, February 1999, Massachusetts Institute of Technology.
- i) *Ocean Tidal Loading Corrections*, Version 1.0, February 1999, NASA Goddard Space Flight Center, et al
- j) *Laser Footprint Location (Geolocation) and Surface Profiles*, Version 3.0, October 2002, NASA Goddard Space Flight Center, et al
- k) *Atmospheric Data Products*, Version 4.2, June 2001, NASA Goddard Space Flight Center, et al
- l) *The Algorithm Theoretical Basis Document for Level 1A Processing*, Version 1.2, December 2002, NASA GSFC/Wallops Flight Facility.

## Section 3

# Product Description

### 3.1 Purpose

GSAS generates the GLAS Standard Data Products and associated metadata describing the products and their quality. The software uses GLAS telemetry and ancillary data to produce the products using algorithms defined by the GLAS Science Team.

GSAS is delivered as a set of libraries and executables (PGEs). The design and structure of GSAS is fully described in the GSAS Detailed Design Document.

Throughout this document, files are referenced as one of two types: GLA or ANC. GLA files are integer-binary format product files containing Level 0-2 GLAS science data. The GLA files are fixed-length binary files containing scientific measurements. GLA files are both input and output to GSAS. ANC files are multi-format ancillary files supplied by the science team which are required for processing. These files are detailed in the GLAS Data Management Plan and GLAS Standard Data Product Specifications Documents.

### 3.2 Environment

GSAS software is developed for and delivered on the UNIX platform. This document assumes that the reader is familiar with UNIX operating system conventions. The software is currently supported only on the HP/UX 11.0 operating system with Fortran 90 version v2.5.

### 3.3 Functions

The GSAS functions for V4.0 are:

- Read GLAS telemetry data and standard data products and ancillary files. Provide time-synchronization between product and ancillary files and between multiple products.
- Create all standard data products in an integer-binary format. These data products are grouped into the following categories:
  - Level-1A products. (GLA01-04)
  - Waveform products. (GLA05)
  - Atmosphere products. (GLA07-11)
  - Elevation products. (GLA06, GLA12-15)
- Perform selective processing based on input and output defined in a user-supplied control file.
- Creates EOS inventory metadata files.

- Maintain a full processing history.
- Report errors and messages in a standardized fashion with user-defined options available.
- Read changeable parameters from Science Team-supplied ancillary files.
- Convert product data into human-readable output.
- Create scientifically accurate data products.

### 3.4 Restrictions and Limitations

The V4.0 delivery of the GSAS has the following limitations:

- The software has the capability of processing many different scenarios. However, only tested scenarios are supported. These scenarios are:
  - One processing string to create all L1A products (GLA00 to GLA01-04).
  - One processing string that starts with an L1A altimetry product (GLA01) input to produce a waveform product (GLA05).
  - One processing string that starts with a waveform product (GLA05) input (and optionally GLA09 and GLA11) to produce all elevation products (GLA06, 12,13,14,15).
  - One processing string that starts with L1A atmosphere (GLA02) input and produces L2 atmosphere products (GLA07,08,09,10,11).
  - One processing string that starts with L1B atmosphere (GLA07) input and produces L2B atmosphere products (GLA08,09,10,11).
- GLA16, and the associated processing software, while referenced in documentation, is not present in the V4.0 delivery.
- Not all utility PGEs conform with GSAS standards regarding control files, file naming, error reporting, and processing history.
- GSAS core and utility PGEs may be run without error if all ANC07 files are specified within the control file. Only specific ANC07 files are required for each PGE, but we have verified that specifying all does not cause an error. This capability was verified in order to avoid a potential SDMS limitation.
- GSAS will **not overwrite** existing files. The software will halt with a fatal error unless old output files are removed before execution.
- Very little process sanity checking is delivered in this version. This will be added in a later delivery.
- The GSAS is supported on HP/UX 11.0 with HP Fortran 90 compiler version 2.5.
- This documentation is limited to GSAS and thus will not describe procedures or utilities within the scope of SDMS.



## Section 4

# Inventory and Product

### 4.1 Materials Released

Materials released include software code, documentation, static ancillary data and test data. These materials may be delivered either electronically or on physical media. The deliver will be broken into multiple tarfiles in order that individual files sizes not exceed 2 GB. The documentation is delivered electronically in the form of Adobe PDF (Portable Document Format) files and, by request, hardcopy.

Tarfiles delivered electronically have the following content:

part\_1.tar : GSAS source code, data and docs  
untars into gsas\_v4.0\_dap/

part\_2.tar : verification test and data  
untars into gsas\_v4.0\_dap/test

part\_3.tar : standalone f90 and IDL readers  
untars into gsas\_v4.0\_dap/scf\_readers and gsas\_v4.0\_dap/idl\_readers

README.txt files are provided in the root level of part\_1.tar, in gsas\_v4.0\_dap, and in gsas\_v4.0\_dap/scf\_readers.

### 4.2 Product Content

To extract the GSAS Version 4.0 software, change to an appropriate directory (suggested at least 6 GB available on the disk) and use the tar command to extract the software from the distribution tarfiles.

When the tarfiles are extracted, a gsas\_v4.0\_dap directory and several sub-directories will be created. Table 4-1 lists the top-level subdirectories.

**Table 4-1 Top-level Content**

Item	Description
README.txt	Detailed inventory file.
data	Delivered ancillary data.
docs	Documentation in PDF format.
gsas	Link to version specific GSAS directory.
gsas_v4.0	GSAS directory.
idl_readers	Sample SCF-provided IDL reader code.
scf_readers	Sample SCF-provided f90 reader code.
test	Verification testing area.

#### 4.2.1 Data (/data)

The data directory contains static ancillary files necessary to run GSAS. Some of these files may be symbolic links into the `gsas/data` directory. Non-linked data files are listed in Table 4-2

**Table 4-2 data Content**

Filename	File Type
ANC33_001_20040506_000000_01_0000.DAT	GLAS ISF/GLAS ISIPS Interface file
anc12_004_01_0000.dat	Coarse-resolution Digital Elevation Model.
anc12_004_01_0001.dat	Fine-resolution Digital Elevation Model.
anc13_004_01_0000.dat	Geoid.
anc16_001_01_0000.dat	Load Tide Coefficients.
anc17_001_01_0000.dat	Ocean Tide Coefficients
anc18_001_01_0000.dat	Standard Atmosphere File.
anc25_001_20021213_000000_01_0000.dat	GPS-UTC Conversion File.
anc27_001_01_0000.dat	Fine-resolution regional mask.
anc27_001_01_0001.dat	Coarse-resolution regional mask.
anc30_001_01_0000.dat	Global aerosol categorization map.
anc31_001_01_0000.dat	Aerosol tropospheric classification map.
anc35_001_01_0000.dat	Ozone file.
anc38_001_01_0000.dat	Multiple-scattering table.
anc41_009_01_0000.dat	JPL Planetary Ephemeris File.

#### 4.2.2 Documentation (/docs)

The required delivery documentation for Version 4.0 is found in the docs directory. These documents are listed in Table 4-3

**Table 4-3 docs Content**

Item	Description
atbd_waveform.pdf	ATBD - Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights
atbd_pod.pdf	ATBD - Precision Orbit Determination (POD)
atbd_pad.pdf	ATBD - Precision Attitude Determination (PAD)
atbd_tropo.pdf	ATBD - Atmospheric Delay Correction to GLAS Laser Altimeter Ranges

**Table 4-3 docs Content**

Item	Description
atbd_tide.pdf	ATBD - Ocean Tidal Loading Corrections
atbd_geolocation.pdf	ATBD - Laser Footprint Location (Geolocation) and Surface Profiles
atbd_atmos.pdf	ATBD - Atmospheric Data Products
atbd_l1a.pdf	ATBD - Level 1A Processing
gsas_ddesign_v4.pdf	GSAS Detailed Design Document, Version 4.
gsas_user_guide_v5.pdf	GSAS User's Guide, Version 5.
gsas_ver_desc_v4.pdf	GSAS Version Description, Version 4 (this document).
glas_prod_spec_1_v7.pdf	GLAS Standard Data Product Spec - Level 1
glas_prod_spec_2_v7.pdf	GLAS Standard Data Product Spec - Level 2
glas_smp_v2.pdf	GLAS Science Software Management Plan
glas_dmp_v2.pdf	GLAS Data Management Plan

### 4.2.3 GSAS Directory (/gsas)

The GSAS directory contains the structure and content needed for GSAS to compile and run. Table 4-4 lists the content of the gsas\_v4.0 directory.

**Table 4-4 GSAS Content**

Item	Description
bin	Directory where executables are stored.
cc_util	Make utilities.
data	Science-team provided static-ancillary files.
lib	Directory where shared libraries are stored.
Makefile	Distribution Makefile.
src	Source code.

The bin and lib directories are delivered without content. They will be populated during the installation process. The remainder of this subsection describes content of the other directories.

#### 4.2.3.1 Makefile utilities (/gsas/cc\_util)

This directory contains GSAS-standard makefile utilities. These files are used in GSAS makefiles and can be modified to change such things as compile-time options in a consistent manner.

**Table 4-5 cc\_util Content**

Item	Description
cc_make_final.sh	Clearcase glue script to ease installation.
make_defs.	Symbolic link to make_defs.hp
make_defs.hp	HP-specific Makefile definitions.
make_defs.sun5	Sun-specific Makefile definitions.
make_defs.incl	Generic Makefile definitions.
make_depends.incl	Makefile dependencies.

#### 4.2.3.2 Ancillary Data (/gsas/data)

Initial versions of the science-team supplied ancillary data files as well as sample control files are included in this release. These files are located in the data directory of the tarfile and reflect the latest versions in operational use.

**Table 4-6 data Content**

Item	Description
anc07_001_00_00.dat	Error and Status file. Generated by development team.
anc07_001_00_01.dat	Global constants file. Generated by development team.
anc07_001_00_02.dat	Atmosphere constants file. Generated by development team.
anc07_001_00_03.dat	Elevation constants file. Generated by development team.
anc07_001_00_04.dat	Waveform constants file. Generated by development team.
anc07_001_00_05.dat	L1A constants file. Generated by development team.
anc07_001_00_06.dat	Utility constants file. Generated by development team.
anc45_*.dat	Product Metadata Template File. Produced for each product type by the development team.
anc46_*.dat	Ancillary Metadata Template File. Produced for each supported ANC type by the development team.

#### 4.2.3.3 Source (/gsas/src)

Contents of the src directory are described in detail within the GSAS Detailed Design Document. Table 4-7 lists each major subdirectory and it's corresponding executable/library version number.

#### 4.2.3.4 IDL (/gsas/idl)

The IDL directory contains IDL programs and libraries used by the Browse and QAP software.

**Table 4-7 src Content**

<b>Item</b>	<b>Description</b>
atmosphere	Development code for atmosphere code.
atm_anc	Atmosphere Utility
atm_lib	Links atmosphere code into library structure.
common_libs/anc_lib	Development directory for anc_lib.
common_libs/cntrl_lib	Development directory for cntrl_lib.
common_libs/err_lib	Development directory for err_lib.
common_libs/file_libt	Development directory for file_libt.
common_libs/geo_libt	Development directory for geo_libt.
common_libs/math_lib	Development directory for math_lib.
common_libs/platform_lib	Development directory for platform_lib.
common_libs/prod_lib	Development directory for prod_lib.
common_libs/time_lib	Development directory for time_lib.
createGran_util	Granule Utility
create_dem	DEM Utility
create_gla16	GLAS L3 PGE (unused)
dem2vis	GLAS Visualizer DEM utility.
elevations	Development code for elevations code.
elev_lib	Links elevation code into library structure.
glas_alt	GLAS Altimetry PGE
glas_atm	GLAS Atmosphere PGE
glas_gps	GLAS GPS processor (unused)
glas_l0p	GLAS L0 PGE
glas_l1a	GLAS L1A PGE
glas_meta	GLAS Metadata processor
glas_reader	GLAS Reader Utility
glas_tick	GLAS Utility PGE.
l1a	<unused>
l1a_lib	Development directory for L1A code
lib	Development shared library directory. (initially empty)
Makefile	Master source Makefile

**Table 4-7 src Content (Continued)**

Item	Description
met_util	Met file Utility
modules	Development module directory. (initially empty.)
NOSE_util	NOSE utility
prod_util	Misc product utilities
reorbit_util	Reference Orbit Utility
track_reader	unused.
waveforms	Development directory for waveforms code
wf_lib	Links Waveforms code into library structure.

#### **4.2.4 IDL Product Readers (/idl\_readers)**

The IDL product readers directory contains sample IDL product reader software contributed by the SCF.

#### **4.2.5 SCF Product Readers (/scf\_readers)**

The SCF product readers directory contains sample F90 product reader software contributed by the SCF. This software does not require the GSAS standard libraries.

#### **4.2.6 Testing and Sample Products (/test)**

The V4.0 delivery version contains, within the test directory, test data and facilities for use in validating correct operation of the delivered software. The content and usage of the test directory is documented in the GSAS Acceptance Test Procedures Document.

## Section 5

# Change Status

The Version 4.0 delivery of GSAS contains major changes from Version 3. The most important changes are changes to reflect updated ATBDs and new functionality provided by additional PGEs.

## 5.1 Installed Changes

### 5.1.1 Science Algorithms

Implemented changes defined in the latest version of the science algorithm ATBDs. These changes are documented in each respective ATBD. The latest ATBDs are available at:

<http://www.csr.utexas.edu/glas/atbd.html>

and

<http://glas.wff.nasa.gov/docs> (L1A).

The versions implemented in the V4.0 delivery are included as PDF files in the 'docs' directory of this distribution. The following table lists the version of each ATBD used for V4.0 development.

**Table 5-1 ATBD Versions Implemented in V4.0**

Title	Version
Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights	July 2000
Precision Orbit Determination (POD)	October 2002
Precision Attitude Determination (PAD)	October 2002
Atmospheric Delay Correction to GLAS Laser Altimeter Ranges	March 2001
Ocean Tidal Loading Corrections	February 1999
Laser Footprint Location (Geolocation) and Surface Profiles	October 2002
Atmospheric Data Products	June 2001
The Algorithm Theoretical Basis Document for Level 1A Processing	October 2002

### 5.1.2 Data Products

Version 4.0 of the data products were implemented as described in the GLAS Standard Data Product Specifications - Level 1 and 2 and the respective ATBDs.

The content and description of the as-implemented Level 1 and 2 products is available at:

[http://glas.wff.nasa.gov/v4\\_products](http://glas.wff.nasa.gov/v4_products)

The content and description of the as-implemented Level 0 APID data is available at:

[http://instra2.gsfc.nasa.gov/glas\\_doc/glas-582-spec-002e.pdf](http://instra2.gsfc.nasa.gov/glas_doc/glas-582-spec-002e.pdf) (science)

[http://instra2.gsfc.nasa.gov/glas\\_doc/glas-582-spec-005c.pdf](http://instra2.gsfc.nasa.gov/glas_doc/glas-582-spec-005c.pdf) (engineering)

### **5.1.3 GLA04 Timing and Sub-packet Alignment**

GLA04 LRS and IST sub-packet time/data alignment was delivered. Numerous tweaks to GLA04 time tagging were implemented.

### **5.1.4 GLA03/L\_Eng**

Engineering data processing (L\_Eng) and the resultant GLA03 product support was delivered.

### **5.1.5 GLAS\_Meta**

The ability to create Ancillary file inventory-level metadata was added to GLAS\_Meta.

### **5.1.6 File Naming Convention**

The supported file naming convention was changed. See Appendix A of the GSAS User Guide.

### **5.1.7 GLAS\_L0proc**

Several error checks were added to GLAS\_L0proc. Added flag byte to ANC32 file The ANC32 creation mechanism was revised to use FTLatch for the GPS update detection.

### **5.1.8 GLAS\_L1A**

GLA01 and GLA02 formats and processing software was modified to support the new APID definitions. Support was added for L\_Att processing. L\_Atm processing was modified to work with new Atmosphere algorithms. Shottime calculation was rewritten for improved maintainability. Instrument biases are now handled.

### **5.1.9 GLAS\_Atm**

Atmosphere algorithms were significantly re-written.

### **5.1.10 GLAS\_Alt Waveforms**

Waveform algorithms were significantly re-written. Parameter values were tuned to reflect instrument characteristic.

### **5.1.11 GLAS\_Alt Elevations**

Added surface-type support to the elevation science algorithms.



### 5.1.12 Utilities

atm\_anc, met\_util, refOrbit\_util, and createGran\_util were updated. A new utility, stripper, was written to assist in processing spacecraft test data.

### 5.1.13 Implemented PR/CRs

The software development team uses Change Requests (CR) and Problem Reports (PR) to identify problems in the software. Table 5-2 lists those PR/CRs addressed from GSAS 3.0 to GSAS 4.0.

**Table 5-2 PR/CRs Addressed in Version 4.0**

PR/CR	Short Description
0001665	Some WFs Have No Alternate Fit
0001659	Calibration Change for 1064 Atmosphere for Laser 1
0001654	Solar Angle Units Need Changing in Product Variable Database
0001653	GLA07 SolAng Change
0001652	Problem While Running ATM on ACCTest
0001651	GLA03 Return Gain Problem
0001650	Problem While Running L1A on ACCTest
0001649	Failed Browse01 Job 259345
0001646	Online Documentation of i_wfQual in GLA05 Needs To Be Changed
0001642	Range Delay is not Calculated Correctly When Optical Depth is Invalid.
0001640	GLAS_Alt Elevations Bombs with SIGFPE in calcsplc:calcangle
0001639	Atmosphere Dies with SIGFPE
0001633	Release 18 anc45 and ESDTs
0001620	GLA06 d_IdRngOff has Impossible Value
0001615	i_rng_UQF (i_RngOffQF) on GLA06 may be Bad in 40th Shot
0001609	Atmosphere Flags Added to Elevation Products
0001608	Some Poorly Fit Waveforms are Shown as Not Fit
0001607	Add GLA11 Cloud Parameters to Elevation Products
0001606	Metadata Science QA Flag Set to "Failed"
0001592	Error in Special Processing in Waveforms
0001590	No Fit For Some Transmitted Pulses
0001587	QAbrowse Fails to Process QAP05 without Valid Along-Track Records
0001580	GLA10 and 11 eta, Range Delay, and lat/lon Problems

**Table 5-2 PR/CRs Addressed in Version 4.0 (Continued)**

PR/CR	Short Description
0001579	GYRO Time Offset
0001543	Geoid is Incorrect in V3.9 Data Products
0001538	Refinement of Time Selection in reorbit_util
0001510	Update ANC07-04 Description
0001497	Add A Flag To WFQual
0001464	ANC45 Updates
0001418	Get Error Running qapg after Adding 8 Chars to GLA File Names
0001397	QAP 01 Problems in Release 16
0001317	GLAS_Atm Bombs in a_interp_met
0000808	Elevation Manager Crashes in update_GLA06QA
0000637	GLA05 QAP File not Limited by ctl File Boundaries

### Waivers

- Detailed Design/User Guide documentation for some subsystems and utilities is not updated.
- GLA16 support is not delivered.
- Precision time calculation when GPS is not present is not yet coded.
- Several PR/CRs have been suspended for a later version.

## 5.2 Possible Problems and Known Errors

Table 5-3 lists the PRs and CRs open for V4.0. These will be corrected in a later delivery.

**Table 5-3 Open or Suspended PR/CRs for Version 4.0**

PR/CR	Short Description
0001674	GLA04 LPA, LRS Image Descriptions Need Clarification/Correction
0001672	QAPCompare, QAPRead Changes for GLA05 Metadata
0001670	Problems with Waveform QA
0001668	Sea Ice Roughness Parameters not Calculated Correctly on GLA13
0001667	QAPG Changes for Metadata Requirements
0001666	QAPG Should get Requested File Times from Control File
0001662	Bad Data in GLA01 When Laser not Operating

**Table 5-3 Open or Suspended PR/CRs for Version 4.0 (Continued) (Continued)**

<b>PR/CR</b>	<b>Short Description</b>
0001657	Add LPA Orientation Parameters to GLA05
0001634	Land/Ocean Flag added to Atmosphere Products
0001631	Revise Documentation for GSAS 4.0 Delivery
0001628	Gain Reported is Delayed in Application
0001625	GLA05 Browse Products: Locations Reported on Along-Track Scatter Plots Incorrect
0001616	GLAS_ATM options sanity checks
0001496	Investigate Area Fit Of Saturated Waveforms
0001472	Atmosphere - 532 Background Problem
0001440	Investigate Differences between Waveforms QAP File and QAPG Output
0001414	Parameter Name Duplication in QAP02 and QAP06
0001403	Merge QAPxx Modules with Elevation Code
0001402	Waveform ATBD Change Needed
0001399	Version Number for QAPRead
0001390	Elevation QAP Changes for Metadata
0001389	QAP04 Changes for Metadata
0001388	QAP03 Change for Metadata
0001387	QAP02 Change for Metadata
0001386	QAP01 changes for Metadata
0001273	No valid QA for GLA08-11
0001267	GLA09 Aerosol / Cloud Discrimination and Layer Detection
0001245	Incorporate SRTM High-Definition DEM into GSAS Software
0001192	Atmosphere Browse Images
0001005	Modify QAPG to Work with Changed QAP03_mod.
0000976	GLA12-15 d_sigmaElv not set
0000934	Attempt to Reduce Memory Requirements of GSAS.
0000898	QAP04: LRS First Valid Star Image Sometimes not Valid
0000839	Release 12 GLA05 Problems Discovered in QA Data
0000647	QAP: Change in Requirement for Along-Track Times
0000617	GLA13 QA Problem Regarding Sea Ice Roughness

**Table 5-3 Open or Suspended PR/CRs for Version 4.0 (Continued) (Continued)**

PR/CR	Short Description
0000520	Data Quality Flags Needed in Metadata
0000519	Inconsistent/incorrect Determination of End of QAP Averaging Period: GLA06,12-15
0000470	Completion of Transmit Quality Flag Testing
0000459	GLA01 Format Description in Error in GLAS Standard Data Products- Level 1
0000428	Check Out Use of Measurements when Delay Line Pulse is Used
0000371	Dry Trope Correction has Blips
0000230	The ATM Level 2 Processing Does not Properly Handle a Large Time Gap
0000226	Guidelines for Special Processing of Saturated WF's have not been Supplied
0000108	Wrong KIND Types for Logicals in Many Modules
0000103	Update the GLAS Science Computing Facility Plan
0000099	Create Draft I-SIPS Training Requirements Guide
0000093	Review Product Descriptions for Atmosphere Products
0000080	New Utility to Create Time Correlation File with No GPS

### 5.3 Requirements Not Supported in the V4 Delivery

Requirements from the GLAS Science Software Requirements Document that are not supported in the V4.0 delivery of the I-SIPS software are shown in Table 5-4.

**Table 5-4 Requirements Not Supported**

Requirements Number	Description	Status
GSDP-30100	The I-SIPS Software will create GLAS standard products that are to be delivered to the DAAC in the format agreed to by ESDIS. (GLA16 creation is not yet delivered).	original

### 5.4 Change Notes

The following are detailed change notes distributed for the interim versions of GSAS released since V3.0.

#### 5.4.1 GSAS 3.1 Release Notes

- Branch CR20020830-001 and CR20020830-002

(GLA02) The calculation of the number of SPCM's enabled (from the SPCM status byte) was included. Prior versions assumed all 8 SPCM's were functioning.

(GLA02) Dead time correction tables were added for each individual SPCM (prior versions had one dead time correction table). Code was added that computed the appropriate dead time correction based on these new tables and which SPCM's are enabled.

(GLA02) Changed normalization of 532 channel from using pin E (laser energy monitor) to pin A (value of laser energy after going through etalon).

(GLA02) 1064 cloud digitizer signal droop correction was added.

(GLA09) The addition of routines to find cloud layers using the 1064 data,. These cloud layers are appended to any that are found from the 532 channel.

(GLA11) Changed the units of the estimated range delay due to multiple scattering from nanoseconds to millimeters. Added the parameter "range delay due to multiple scattering uncertainty"

The correction of a bug in the 20 second buffering that produced invalid times when there was a data gap. This affected all level 2 products.

- Branch PR20021204-001

The cloud digitizer attenuation setting was not decoded from the telemetry byte. Code was added to decode this byte and apply the proper attenuation setting correction to the data.

- Branch CR20021023-003

Implemented instrument state. Default instrument state be provided by ANC33. Changed ANC33 format to support this. State is updated in the L1A Manager based on available APIDs. Changed states are recorded in the `exec_lib/inst_state_mod.f90`. Added `instrument_state_date` and `instrument_state_time` to ANC45 file and associated ESDTs. (CR 20021023-003)

Implemented code to convert from char19 to J2000 times.

Added code to pass-thru instrument state from prior granules.

Implemented routines to update `timing_bias` and `range_bias` in header/metadata. Added date/times for each bias to the ANC45 files and associated ESDTs.

Added code to update internal range/time delays and osc rates in headers.

Fixed problems in APID55 coding (CR20021106-003).

Straightened out energy calculation variables per meeting with Hancock. Changed gain parameters for energy calculation (CR20021107-002).

Found a bug whereby if the actual number of header records on a product was less than the estimated number of header records, the header fields contained the actual,

not estimated, and one or more empty header records were left in the product. Fixed this by making the value in the header the estimated number of header records.

Also fixed a potential problem with empty product files by calling the header write routines immediately after initialization. (CR20021104-004/CR20020923-001)

Made the L1A (GLA01/GLA02) manager respect the start/stop time of the output file when creating QAP data (PR20021118-002).

Updated to rev C of the PRAP packet. Changed structure of GLA0406 (need to fix database!). Modified L\_Att to use the ADCS\_VTCW for GLA06 UTC time computation.(CR20021030-001/CR20021025-003)

Fixed filename parsing routines to recognize the ANC39 file naming convention requested by UTexas (CR20021107-001).

Removed QA information from the product headers. (CR20021104-005; Second part of this CR, to change GLAS\_Meta to update the QA based on metadata, is TBD)

Handled unsigned values within L\_Att for VT centroid row/col in LRS and IST data (PR20021126-002).

- Branch CR20021106-002

Updated the L\_Eng code to match the updated Version 1.1 L1A ATBD. Both the L\_Eng code and the L1A constants file were updated to match the L1A ATBD modifications.

- Branch CR20021205-001

Cleaned up GLA04-01, GLA04-03, GLA04-04, and GLA04-06 variable definitions and structure formats (CR20021205-001).

Modified the timetag rollover algorithm to give better LRS/IST alignment results. Fixed a case where the lrs\_coi was being used when the ist\_coi should have.

Branch scantime contains the following:

Created a new product utility PGE, scantime, to assist in the maintenance of anc33. The utility will read anc29 (created by GLAS\_L0proc) and APIDs 19, 20, 21, 24, and 55. It will scan the data for differences between times computed by GPS correlation and those estimated by MET. It will also detect any changes to the instrument state variable. If a change in the time difference or instrument state is detected, it will write a record to an output ANC33 file.

- Branches wcr20020918-001, cr20020918-001, wpr20021002-001, and pr20021002-001

In general this modification was intended to go over all common flags and to verify and/or rectify the setting of those flags to valid values in all phases of the GLAS products. There still exist numerous "options" in the data that are not yet realized, and in these cases the default values have been appropriately set. An effort was made to standardize the presentation of all product software and flags, especially so in the

formulation of algorithm flags as arrays of individual flags rather than byte-compacted single variables as used in the product phase of the data processing. This removes the bit-checking complexities from the main stream of data processing and centralizes all such functionalities into the `common_flags_mod.f90` code. It can be generalized that very small changes were made to a large number of modules, as evidenced by the 55 modules involved in the effected branches. The time corflg was propagated to all products.

- Branch cr20021118-001

This branch added the beam parameters to the product files for GLA05-15. No code was added to compute these parameters or to transfer value, but rather to just create places for the data to exist in future versions of the software. Structures in the alg and prod modules were modified, utilizing some of the spare bits in the prod modules. The scal modules were given the conversion software to allow transference between prod and alg variables. The atmosphere manager and buffering module required changes because one variable was deleted in the atmospheres product list to make way for the `beam_coelev` and `beam_azimuth` parameters.

- Branch 20021205-001

Modified the GLA04 scales/formats as requested in the CR. Found a problem in the timetag rollover scheme which hurt alignment results. Significantly improved IST and LRS alignment with corrected algorithm.

- Branch 20021213-001:

GLAS\_L0proc will create an ANC32 file from PRAP if no APID19 is available (CR20021213-001). Changed GLA02-04 VTCentR/VTCentrC units from pixels to arc-seconds (CR20021213-003). Fixed a merge problem with the ANC04-06 GPS\_Latch and GPS\_Time text output.

#### **5.4.2 GSAS v3.2 Release Notes**

GSAS 3.2 is a minor release which allows for better time computations when GLA04 is created without an APID19 and adds the capability to retrieve orbit degradation information from ANC08 POD files.

#### **Release Information**

The ClearCase label for this release is `RELEASE_3.2`.

The release date is January 5, 2003.

Internal version numbers have been updated to "V3.2 January 2003" for the following:

```
./data/anc07_001_01_0000.dat
./data/anc07_001_01_0005.dat
./bin/GLAS_Alt
./bin/GLAS_Atm
./bin/GLAS_L1A
./bin/GLAS_L0proc
./lib/libatm.sl
```

```
./lib/libanc.sl  
./lib/libexec.sl  
./lib/libplatform.sl  
./lib/libprod.sl  
./lib/libelev.sl  
./lib/liblla.sl
```

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at "V3.1 December 2002".

### Product Changes

No product sizes were changed.

Scale factors and units were changed for some variables in GLA04-02 and GLA04-03 (see detailed change notes section).

The definition of orbflg was changed in all products which contain the flag.

### Detailed Change Notes

- PR20021217-001 / PR20021217-002

The purpose of this branch is to re-work timing routines such that creating GLA04 without APID19 gives time computations as close as possible to those computed when using APID19.

Moved GPS rollover code to anc32\_gps\_mod (check\_anc32\_roll). Rollover code invoked immediately after anc32 files are read.

Moved GPS synchronization code to anc32\_gps\_mod (sync\_anc32). Now called from ReadData.

Moved ANC25 synchronization code to anc25\_gpsutc\_mod. Now called from ReadData.

Sync ANC32 with PRAP gpslatch if processing PRAP only.

- PR20021223-002

The purpose of this branch is to fix / change various GLA04 parameters.

Changed the algorithm scale of GLA04-03 GYRO time tag (i\_siru\_ttag) to 1.0d-6 so that the algorithm units are seconds.

Modified L\_Att to apply a conversion factor of 0.05 to GLA04-03 GYRO siruA,B,C,and D integrated angle. This changes the algorithm units to arc seconds.

Changed the algorithm scale of GLA04-02 (LRS row / col) – to 1d-06 to keep precision.

- Branches cr20021118-001, wcr20021213-002, cr20021213-002



This set of software changes added the capability to retrieve the orbit degradation information from the ANC08 POD orbit files. The structure of the orbflg variable (product side) and of the podflg variable (algorithm side) were altered to accommodate changes in the definitions of the flag words. The software translates the degradation data, which is stored in keyword format, into the numerical/bit-wise storage used in the product flags. Although changes in most of the listed modules were small, the anc08\_pod\_mod.f90 underwent a major overhaul.

### 5.4.3 GSAS v3.2.1 Release Notes

GSAS 3.2.1 is a minor release which fixes (1) a problem caused by duplicate APIDs (2) minor GLA04 problems, and (3) transfer-orbit-related fix to create Gran\_util.

#### Release Information

The ClearCase label for this release is RELEASE\_3.2.1.

The release date is January 30, 2003

Internal version numbers have been updated to "V3.2.1 January 2003" for the following:

```
./data/anc07_001_01_0005.dat
./bin/GLAS_L0proc
./lib/libexec.sl
./lib/libprod.sl
```

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at "V3.1 December 2002" or "V3.2 January 2003".

**There is a control file change required by this release.** Here is the developer's description of this change:

*"I have modified my create Gran\_util program to accept an additional argument in the control file. The argument is called*

*LAST\_TRACK, and it will be equal to the track number associated with the last entry in the rev table.*

*For example the last rev in the rev table is 204, and the track number associated with that rev is 196, then you will need to insert into the control file the following line:*

*LAST\_TRACK = 196*

*My program will read that in and start seeding the granule, and scf table with that value."*

#### Product Changes

No product sizes were changed.

Scale factors and units were changed for some variables in GLA04-03 and GLA04-05 (see detailed change notes section).

### Detailed Change Notes

- PR0000105: GLA04\_scal\_mod does not handle solar angle flags correctly

Code which did the P2A and A2P transition for the solar angle flags was completely missing. It has been put back in.

- PR0000119/120: Fix GLA00 to handle duplicate data

This fixed a problem where a duplicate file unit number was assigned to multiple granules of 1984 data. This caused data corruption issues and the wrong data was read under certain conditions.

- PR0000132: GLA04-05 starx and stary should have scale of 0.5

Changed the scale factor of ball start tracker (GLA04-05) starx and stary in ANC07\_05 to 0.5.

- PR000085: GL0P sanity check on GPS time

The following conditions are used to check GPS time validity:

- If GPS time does not increment, increment useflag by 2.
- If Current-Previous GPS Time is greater than 60s, increment useflag of both previous record and current record by 4.
- If  $\text{mod}(\text{GPSTime}, 10) > 0.5$ , increment useflag by 8.
- If  $\text{mod}((d\_vtcwp / 10e-6), 10) > 0.5$ , increment useflag by 64.

As a note, a non-zero useflag will signal that the associated ANC32 record not be used. This record will never show up on any output.

- PR0000124: CreateGran\_util generates duplicate track numbers while running in transfer orbit mode

During the normal processing on SDMS, it was noticed that there were duplicate tracks generated by createGran for different time periods. This causes Granule names that are incorrect. This branch fixes that problem.

#### 5.4.4 GSAS v3.2.2 Release Notes

GSAS 3.2.2 is a minor release which fixes (1) a problem caused by an offset between the GLAS and SC MET counts, (2) a minor GLA04 conversion change, and (3) another transfer-orbit-related fix to createGran\_util.

#### Release Information

The ClearCase label for this release is RELEASE\_3.2.2.

The release date is February 05, 2003.

Internal version numbers have been updated to "V3.2.2 February 2003" for the following:

```
./data/anc07_001_01_0000.dat
./bin/GLAS_L0proc
```

`./lib/libprod.sl`

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at "V3.1 December 2002", "V3.2 January 2003", or "V3.2.1 January 2003".

A new version of the ANC33 file, which removes the work around-line, IS REQUIRED!

### Product Changes

No product sizes were changed.

The parameters boreh and borev in GLA04-04 are now correctly converted to arcseconds.

### Detailed Change Notes

- PR0000135: GLOP error in record index when switching grouping packet type

The software sorts the APIDs, based on unconverted MET, before assigning rec\_ndx. Since the GLAS and SC METs are set differently, this sorting does not work as expected. To solve this issue, I have taken the conservative approach of moving the sort to a point after METs are replaced by UTC Times. However, this means that each individual APID must be matched against the ANC33 file in order to find the correct MET offsets.

- PR0000136: GL0P sanity check that packets grouped are within 1 second

Added a check within GLAS\_L0proc which verifies that  $\text{abs}((\text{utctime} * 10) - \text{recndx}) \leq 10$ .

- PR0000137: L1A sanity check that record index is in order

Added code to GLA00\_mod which checks that rec\_ndx and utc time do not move backwards.

- PR000084: IST boresight H and V is not in arcseconds

Removed asec2amin conversion from L\_Att.

- PR0000124: CreateGran\_util generates duplicate track numbers while running in transfer orbit mode

During the normal processing on SDMS, it was noticed that there were duplicate tracks generated by createGran for different time periods. This causes Granule names that are incorrect.

### 5.4.5 GSAS v3.3 Release Notes

GSAS 3.3 adds functionality to GSAS. Major features new to v3.3. are waveform scaling, QAP03, and PAD degradation functionality.

### Release Information

The ClearCase label for this release is RELEASE\_3.3.

The release date is February 14, 2003.

Internal version numbers have been updated to "V3.3 February 2003" for the following:

```
./data/anc07_001_01_0000.dat
./data/anc07_001_01_0001.dat.
/data/anc07_001_01_0004.dat
./data/anc07_001_01_0005.dat
./bin/GLAS_L1A
./bin/GLAS_Alt
./bin/GLAS_Atm
./lib/libanc.sl
./lib/libplatform.sl
./lib/libprod.sl
./lib/libl1a.sl
./lib/libwf.sl
```

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at "V3.1 December 2002", "V3.2 January 2003", "V3.2.1 January 2003", or "V3.2.2 February 2003".

### Product Changes

No product sizes were changed. The structure of the attflg1 variable (product side) and of the attflg variable (algorithm side) were altered to accommodate changes in the definitions of the flag words.

Several changes were made to GLA05 units. See the CR2002113-002 detailed change notes for more information.

### Detailed Change Notes

- CR20021213-002 : PAD Degradation Header Support

This set of software changes added the capability to retrieve the attitude degradation information from the ANC09 PAD precision attitude files. The structure of the attflg1 variable (product side) and of the attflg variable (algorithm side) were altered to accommodate changes in the definitions of the flag words. The software translates the degradation data, which is stored in keyword format, into the numerical/bit-wise storage used in the product flags. Although changes in most of the listed modules were small, the anc09\_pad\_mod.f90 underwent a major overhaul.

- CR20021113-002: Waveform Scaling

Waveform raw counts are converted to volts (using a lookup table of 256 values) - in L1A (L\_Alt) and L1B (WFMgr). All computations on waveforms are done on these re-scaled values. The raw counts are still on the GLA01 product.

The waveform lookup table needs to be in the GLA01 header record(s). Added gd\_minVolts & gd\_maxVolts to const\_glob\_mod. Their values are computed from

d\_cnt2voltTable when it is read in anc07\_glob\_mod and may be used for sanity checks instead of 0 and 255.

GLA01%%d\_4nsBgMean is in 0.01 counts. d\_bgNoiseOb is obtained from it by interpolating from d\_cnt2voltTable. d\_sDevNsOb is scaled from the table by converting  $(d\_4nsBgMean + d\_4nsbgSDEV)$ , and then d\_bgNoiseOb is subtracted.

Temperatures used in the new energy calc are obtained from gla03 or gla00 in L1AMgr\_mod.

GLAS\_Alt requires anc07\_001\_01\_0001.dat for the energy calibration coefficients and the waveforms.

i\_InstState is checked for the WF digitizer, and temperature detector. i\_InstState is set in L1AMgr\_mod from anc33. Fixed anc33 so i\_InstState indicates digitizer 1 and detector1. Everything in anc07\_001\_01\_0004.dat that is in counts is converted to volts before being used. d\_satAmp was added to anc07\_Indep, and i\_Min4Sat was changed from 3 to 1.

The energy calculations were updated.

Fixed CalcInstrCentroid and problem with l\_badFrame(2) in W\_Assess\_mod. l\_badFrame is used to set i\_altFrmFlg(3) (goodness of fit, now is 0 if all WF are good). Fixed centroid QA. d\_centroid is an offset from the digitizer address of the last gate.

Changed d\_gval\_rcv & d\_gval\_tx to i\_gval\_rcv & i\_gval\_tx on gla05\_alg. Changed i\_areaTrWF from i4b(40) to i2b(40) + i\_spare2 i2b(40). Changed d\_wfnoiseOb & d\_sDevNsOb to 0.0001 volts on product. Changed units for d\_maxRecAmp, d\_maxSmAmp, d\_parm(noise & amp), d\_solnSigmas(noise & amp), d\_wfFitSDev, d\_parmTr(noise & amp), d\_sDevFitTr, & d\_maxTrAmp to millivolts on gla05. Changed units for d\_areaTrWF & d\_areaRecWF to 0.01volts \* ns on gla05.

- AI2002033: QAP03 – Engineering QAP

QAP03 is a release that provides quality assurance functionality for the GLA03 data product. The GLA03 product underwent three changes as a result of the QAP03 testing and implementation.

The GLA03 product set the sixteenth second to a flag of 3 in the APID Availability flag, this was corrected.

Data that was available during the third second of items that occurred once every four seconds was not being used, this was corrected.

The time and position packet (SCPosPkt) was not passed from GLA00 to GLA03, this was corrected.

QAP 03 was created and includes expected number of APIDs based on the time that is requested in the control file. Stats included in QAP03: Actual number of records per APID, percentage of missing data per APID, granule statistics that include maximum, minimum, average, standard deviation, and number of points for each current,

voltage, and temperature. The number of points out of bounds was not in this release. Along track statistics were implemented for each current, temperature, and voltage.

#### **5.4.6 GSAS v3.3.1 Release Notes**

GSAS 3.3.1 is a minor release which adds basic sanity checking for GLAS\_L0proc and GLAS\_L1A control file specifications.

##### **Release Information**

The ClearCase label for this release is RELEASE\_3.3.1.

The release date is February 19, 2003.

Internal version numbers have been updated to "V3.3.1 February 2003" for the following:

```
./data/anc07_001_01_0000.dat  
./bin/GLAS_L0proc  
./bin/GLAS_L1A  
./lib/err.sl
```

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at their previous versions.

GLAS\_L0proc and GLAS\_L1A will now die with a fatal error (status=3) if a sanity-check violation is detected. See the detailed release notes to determine what checks are performed.

##### **Product Changes**

No product sizes were changed.

The product parameters were changed.

##### **Detailed Change Notes**

- CPR0000164: Sanity check duplicate APIDs in GLAS\_L0proc and GLAS\_L1A

Added the following sanity checks for GLAS\_L0proc and GLAS\_L1A. If a sanity check violation is detected, the PGE exits with a FATAL status (status=3)

##### **GLAS\_L0proc sanity checks:**

Cannot have more than one input of a particular GLA00 APID.

Must have at least one GLA00 input.

Must have an ANC33 input.

Cannot have more than one ANC33 input.

Must have an ANC07 input.

Must have an ANC29 output.

Cannot have more than one ANC29 output.

Must have an ANC32 output.

Cannot have more than one ANC32 output.

Must have an ANC06 output.

**GLAS\_L1A sanity checks:**

Must have an ANC33 input.

Cannot have more than one ANC33 input.

Must have an ANC25 input.

Cannot have more than one ANC25 input.

Must have an ANC07 input.

Must have an ANC32 input.

Must have an ANC29 input.

Number of ANC29 inputs must equal number of ANC32 inputs.

Cannot have more GLA00s of an APID type than the number of ANC29 inputs.

Must have an ANC06 output.

Must have anc ANC20 input if POSITION  $\neq$  PASS\_THRU

Must have GLA01 output if L\_ALT flag set

Must have same number of QAP01 outputs and GLA01 outputs

Must have ANC4501 input if GLA01 output.

Must have GLA02 output if L\_ATM flag set

Must have same number of QAP02 outputs and GLA02 outputs

Must have ANC4502 input if GLA02 output.

Must have GLA03 output if L\_ENG flag set

Must have same number of QAP03 outputs and GLA03 outputs

Must have ANC4503 input if GLA03 output.

Must have GLA0401-06 output if L\_ATT flag set

Must have ANC4504 input if GLA04 output.

**5.4.7 GSAS v3.3.2 Release Notes**

GSAS 3.3.2 is a minor release which adds additional sanity checking for GLAS\_L0proc and GLAS\_L1A control file specifications, fixes energies and temperatures in L1A, and provides some additional fixes in waveforms.

## Release Information

The ClearCase label for this release is RELEASE\_3.3.1.

The release date is February 19, 2003.

Internal version numbers have been updated to "V3.3.1 February 2003" for the following:

```
./data/anc07_001_01_0000.dat
./bin/GLAS_L0proc
./bin/GLAS_L1A
./lib/err.sl
```

This should be verified during operation by checking the version information in the appropriate ANC06 files.

All other internal version numbers remain at their previous versions.

GLAS\_L0proc and GLAS\_L1A die with a fatal error (status=3) if a sanity-check violation is detected. There are significantly more substantial checks made to ensure that the APIDs used with an ANC29 was created in GLAS\_L0proc and the EXACT same APIDS used when ANC29 is read in GLAS\_L1A.

## Product Changes

No product sizes were changed.

The product parameters were changed.

## Detailed Change Notes

- CR0000177 : Work-around for EDOS-filled APID12/13/26 packets

All 10 of the APID12/13/26 sub-packet shot counters are now checked for valid range (as opposed to just the first counter being checked). This should help us detect EDOS filled packets better.

- PR0000176 : GLA01 energy computation is giving negative values

Modified the code to take pass the gain to C\_CalcNrg directly from the APID without conversion into volts. Also fixed the problem with Engineering data on GLA01 where the code was not handling the 1/4sec engineering data rate correctly. Status still poses a problem, so the temperatures are initialized to -27.21 deg on startup. Code which uses these temperatures MUST check the appropriate APID\_Av\_Flg to determine if the temperatures are valid.

Also fixed logic error in C\_CalcNrg where energy values would not be returned if compression was off (ie: Step=1).

- PR0000172 : WFMgr crashes when called without anc09

g\_havePAD is checked before calling get\_anc09\_degrades. Various IEEE errors were fixed by checking for non-waveforms. The minimum amplitude for saturation (in counts) was added to anc07\_001\_01\_0004.dat and the code that reads it.



- CR0000159 : Subscript out of bounds in c\_calcnrg\_mod

Fixed by detecting cases where there are no waveforms.

- CR0000154 : modify anc08 software for efficient space allocation

Software in this module, though functional, was utilizing an inefficient data array allocation scheme. It requested a space size based upon a maximized value of the number of header elements that might contain degradation data. It was changed to mimic a similar function used in the anc09 code, which implements a preliminary step to read through the list of degradations in the header and to count them. The file is then rewound, an exact space size is allocated, and the data is read into memory.

- CR0000158 : Divide by 0 in qap01\_computetrndsum

The software changes in this branch/module were minimal. A divide by error check was using the wrong variable, thus nullifying the check's value. This coding error was corrected.

- CR0000121 GL0P Sanity checking interface to L1A

Have implemented comparisons between the ANC29 record and the following input data, dependent upon the source APID:

```

12 GLA00_prod%AD_LgSci(1)%subpkt(1)%sp%i_shot_ctr
13 GLA00_prod%AD_SmSci(1)%subpkt(1)%sp%i_shot_ctr
14 GLA00_prod%AD_Eng(1)%subpkt%sp%i_shot_ctr
15 GLA00_prod%PC_Sci(1)%i_shot_ctr
16 GLA00_prod%PC_Eng(1)%i_shot_ctr
17 GLA00_prod%CD_Sci(1)%i_shot_ctr
18 GLA00_prod%CD_Eng(1)%i_shot_ctr
19 GLA00_prod%AN_Sci(1)%shot(1)%i_ctr
20 phdr%i_seqcnt
21 phdr%i_seqcnt
22 phdr%i_seqcnt
23 phdr%i_seqcnt
24 phdr%i_seqcnt
25 phdr%i_seqcnt
26 GLA00_prod%LPA(1)%subpkt(1)%i_shot_ctr
27 phdr%i_seqcnt
28 phdr%i_seqcnt
31 phdr%i_seqcnt
32 phdr%i_seqcnt
33 phdr%i_seqcnt
34 phdr%i_seqcnt
35 phdr%i_seqcnt
36 phdr%i_seqcnt 3
8 phdr%i_seqcnt
48 phdr%i_seqcnt
49 phdr%i_seqcnt
50 phdr%i_seqcnt
55 GLA00_prod%Lg_SW2(1)% iAD_Shot_ct
126 phdr%i_seqcnt
1984 phdr%i_seqcnt

```

Also implemented a scheme such that input APID CRC values are stored in the ANC29 and ANC32 headers during GLAS\_L0proc execution. Upon GLAS\_L1A exe-

cution these stored values are compared with CRC checksums of the L1A input APIDs to guarantee that the correct APID/ ANC29 correlations have been chosen.

#### **5.4.8 GSAS v3.4 Release Notes**

GSAS 3.4 is a semi-major release which resolves 35 software change requests and/or software problem reports. Major new functionality includes a fix for the 19m range offset, ability to correctly handle GPS resets (ie: no more backwards time), better IST/LRS alignment, corrected flag words, maximum peak waveform processing, and more optimum L1A atmosphere processing. A brief summary of the major changes follows:

The 19m range offset induced by a bad range offset has been corrected

IST/LRS alignment has been improved by reworking the alignment algorithm. Additionally, known problems with the instrument data for the IST coi and LRS timetag have been handled within the code. New flags have been added to the GLA04 LRS and IST products to indicate what corrections have been made and the success of the alignment process.

The spacecraft GPS resets were causing problems with GSAS time alignment. In some cases, this resulted in inconsistent or reversed timing information. More sanity checks have been added to the L0 processing to prevent these inconsistencies. Additionally, a backwards-time check was implemented to ensure that no time reversals occur on the output products. • Several flag words were encoded/ decoded incorrectly. The problem with the waveform quality flags requires that V3.4 use only that data which have been processed with V3.4.

The ice sheet/sea ice/ocean elevations are now determined by using the maximum peak instead of the last peak of the waveforms.

The co-elevation and beam azimuth have been added to the level 1b and higher data products. These are the "direction of the incident laser pulse at the illuminated spot on the surface, with respect to a topocentric coordinate system defined by the zenith direction at the spot". This laser direction in the topocentric system can be expressed in terms of a co-elevation angle and an azimuth. The co-elevation gives the angle between the spot zenith direction and the laser direction. The co-elevation is closely equal to the off-nadir angle at the spacecraft for small angles. This azimuth and co-elevation would be reported by an observer illuminated by the GLAS laser and the observer would give this azimuth and coelevation as the direction from which the pulse came.

The 1064 channel droop correction algorithm was enhanced to improve atmosphere images.

#### **Release Information**

The ClearCase label for this release is RELEASE\_3.4.

The release date is March 27, 2003.

All internal version numbers have been updated to "V3.4 March 2003."

This should be verified during operation by checking the version information in the appropriate ANC06 files.

New versions of ALL the ANC07 data files are required:

New versions of ALL the ANC45 and ANC46 data files are required.

A new version of the ANC33 file is required and will be provided by ISF.

A new input file (ANC41) is required for GLAS\_Alt (both Elevations and Waveforms) and GLAS\_Atm. This will change the planners for GLAS\_Alt Elevations, GLAS\_Alt Waveforms, and GLAS\_Atm.

### **Product Changes**

No product sizes were changed.

The following product content changes were made:

GLA01: i\_ADdetOutGn units changed from unitless to counts.

GLA01: i\_gainSet1064 units changed from unitless to counts.

GLA02: i\_et\_StartTemp changed from i2b to i1b, scale changed to 1.0d0.

GLA02: i\_et\_StopTemp changed from i2b to i1b, scale changed to 1.0d0. Position shifted to offset 26593.

GLA02: i\_et\_TempStep changed from i2b to i1b, scale changed to 1.0d0. Position shifted to offset 26594.

GLA02: i\_et\_spares (3 bytes) was added to pad the product to previous size. Position starts at offset 56595.

GLA03: i\_ct\_prail\_v min/max changed to -10000, 20000.

GLA03: i\_ADdetOutGn name changed to i\_ADdetOutGn\_v.

GLA03: i\_et\_StartTemp scale changed to 1.0.

GLA03: i\_et\_StopTemp scale changed to 1.0.

GLA03: i\_et\_TempStep scale changed to 1.0.

GLA04-02: i\_lrs\_tspare1 replaced by i\_lrs\_flag

GLA04-04: i\_ist\_tspare2 replaced by i\_ist\_flag.

GLA05: description updated for i\_gval\_tx.

GLA05: description updated for i\_gval\_rcv.

The MSB/LSB is more clearly defined in the PDF flag descriptions. Additionally, changes in the PDF flag descriptions were made for the following flags:

- i\_WFqual
- i\_APID\_AvFlg
- i\_lrs\_flag (new)
- i\_ist\_flag (new)

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v34\\_products/](http://glas.wff.nasa.gov/v34_products/).

### Detailed Change Notes

- CR0000097 : Calculate the Sun Position and Beam Co-Elevation
- CR0000192 : Calculate sun angle etc in the elevation manager
- CR0000193 : Calculate sun angle etc in the ATM manager
- CR0000194 : Calculate sun angle etc in the waveform manager

Now filling Sun Angle, Beam co-elevation, and azimuth in GLA05, GLA06, GLA07, and GLA12-15. See 'Introduction' for more information.

- PR0000107 : QAP expected records statistic may be wrong

Rectified on branches pr107 and wpr107. For QAP01 and QAP02, the file start and stop times were fed in through the calling sequences (as needed) and are used to present the start and stop times.

- PR0000146 : QAP Status Compute sometimes crashed with SIGFPE

Code changes in QAP01 module made as per recommendation, on branch wcr146. The solution required simplifying some of the internal code structure.

- CR0000157 : GLA04-04 IST data has bad center of integration

SRS team suggest that we use the IST data that has bad COI and bad time tag.

On IST COI: If COI is  $< -0.120$  seconds then use the previous COI (or if first COI less than  $-0.120$  sec use nearest good COI) that is  $> -0.120$  seconds

On IST time tag: If IST time tag  $> 1$  then use the fractional part. Align to vctw in same manner (use 0.8, 0.9, to previous vtcw then shift to current when time tag rolls back to 0.0xx)

Additionally, add a flag byte per sample. 1 bit to tell we faked COI, 1 bit to tell we faked time tag, 1 bit to say no alignment sample found.

Fixed this as requested. Also added flag to LRS data indicating missed record alignments and missed frame alignments.

- PR0000160 : Wrong limits for GLA05 QA histograms

Three GLA05 QA parameters were changed to report data in volts rather than counts. The histogram min and max values in the QA summary record were fixed to reflect this change. (dQAMinNsSigmas,dQAMaxNsSigmas) & (dQAMinAmpSigmas,dQAMaxAmpSigmas) are now  $[-0.3,3.0]$  instead of  $[0,20]$ . (dQAMinSDevFit,dQAMaxSDevFit) is now  $[0,3]$  instead of  $[0,20]$ .

- CR0000166 : GLA02 and GLA03 are inconsistent with regards to Etalon temperatures

Instrument team recommends keeping as a 1 byte thing on GLA03 and changing to 1 byte thing on GLA02. The scale factor on both should be 1. Code was changed on branch CR0000166 so that the i\_et\_StartTemp, i\_et\_StopTemp, i\_TempStep would have matching scales.

- PR0000173 : ftn00 file is created when L\_Alt is run with elevation

Duplicate of PR0000174.

- PR0000174 : Stack error with GLA14 QAP file

Problem is a composite of two things. First is that the ElevMgr can still call routines for output of QAP even when those files are specifically selected "null" in the control file. This was fixed in the ElevMgr\_mod. Second is yet another problem with a standard deviation computation, this time in module ElevQA\_mod. Random fluctuations in data and/or "nonphysical" values can cause the stdev computation to try to take SQRT of negative number. Protective code supplied. All corrections done on branch cr174.

- PR0000178 : Investigate QAP03 issues

Modified L\_Eng and QAP03\_mod to fix the along track times, and latitude and longitude. A check was put into the calculations for apid 21 to check for unsigned which fixed the apid 21 numbers.

- PR0000179 : wfqual flag is incorrect

There are problems with wfqual both in how the bits are set and in the pdf documentation in the data base. Fixed problems with not setting the noTrPulse flag in l\_wfQual, and surfType. See also 0000189, & 0000190

- PR0000181 : L\_Atm dies when there are missing waveform packets

L\_Atm incorrectly assumes that if one waveform packet is available, all waveform packets are available. This enables a bad value to get into d\_Rng\_PkRt, which eventually causes gla02\_a2p to die. Fixed the problem by changing the code in L1AMgr to check the APID\_Av\_Flg.

- PR0000185 : anc08/anc09 time values should be referenced to file start time

Reworked internal degradations storage to save data internally in time format referenced to absolute time and not to start of file.

- PR0000186 : IEEE error in e\_calcslope

d\_xmit\_pulsWdS was not checked for invalid and was invalid. Added invalid check to other existing invalid checks.

- PR0000189/PR0000190 : surfType/wfQual packs into wrong bits

The surfType flags were packed into the wrong bits. Also fixed same error in rngCorrFlg and l\_wfQual.

- PR0000195 : Waveforms QA arrays outside allocated boundaries

Duplicate of PR0000236.

- PR0000209 : The bits for i\_rngCorrFlg are being set in the wrong byte on the product

The bits for i\_rngCorrFlg were being set in the wrong byte on the product. The documentation has GLAxx%i\_rngCorrFlg(1:7) stored in bits 0:6 in GLAxx\_prod%i\_rngCorrFlg, where bit 0 is the least significant bit of GLAxx\_prod%i\_rngCorrFlg(2). The code in funpk\_RngCorrFlg & fpk\_RngCorrFlg was storing the bits in GLAxx\_prod%i\_rngCorrFlg(1).

- CR0000218 : GPS reset can cause bad entry in the ANC32 file

On day 54 at 6:55 the GPS reset and did not output ticks for about 30 seconds. This caused an entry in the anc32 which latched the various clocks at the wrong time. As a result, output products had a backwards time increment.

Implemented a fix where the deltas of the ANC32 elements are divided by the expected increment and then compared. A bad comparison causes the ANC32 record to be flagged and unused during processing.

- PR0000222 : No Fit For Transmitted Pulse

When the transmitted pulse has more than one gaussian peak, the fitting procedure is keeping the last peak (this looks like some kind of ringing) and throwing out the peak with the maximum amplitude.

This has been fixed in W\_Assess on branch pr0000179 by increasing the fitting threshold to 30% of (max\_peak\_amp - noise). The transmitted pulse is also not being fit when there is no received waveform (all noise - see PR0000225).

- PR0000234 : Anc08 needs to use internal header file start time

Software now uses start and duration times stored internal to the file to compute time over which the degradation flags should be set. Resolution is made on branch wcr234. Also required a minor change to anc07 file to downgrade severity.

- PR0000236 : Waveform assessment has Segmentation fault error on some jobs

Fixed in WFMgr\_mod. The current QA index was checked for the end of a 16 second QA record within an if-block that was visited only if there was an output QAP file specified.

- CR0000239 : IST time tag has 'large' negative value

Further investigation determined that the large negative values were actually caused by a single 0 value which messed up the rollover code. The rule adopted was to delete the entire IST frame if an IST timetag had value=0. The fix was tested with the 02/23/03 data where backwards times were reported.

- CR0000240 : Sanity check for backwards output times

Added time check against UTCTime, UTCTime+deltas, and sample times, as appropriate. The changes were added into WriteL1A, WriteAtm, and WriteElev for minimum impact upon other code.

- CR0000244 : GLA02 1064 Droop Correction

The 1064 channel droop correction algorithm produces a range dependent signal and also magnifies the ambient signal noise causing a streaky looking image. This has been fixed in L\_Atm.

- CR0000250 : anc09 needs to use internal header file start time

Fixed issue with ANC09 start time (same issue as POD in PR0000234).

- CR0000253 : GLAS\_Alt overflows array in ElevMgr

rl\_wfQual flags gwi\_noFit1, gwi\_noFit2, gwi\_noSig1, & gwi\_noSig2 were not being set if the frame was bad or if the waveform was invalid.

Various places in ElevMgr check these flags & if the noSig or noFit flags were not properly set, then it crashed.

- CR0000275 : ANC33 file has wrong sign for range offset.

Fixed the sign of the digitizer internal range delay in the ANC33 file. This error caused a 19m range error.

Changed the d\_rDelay\_digtzr to 9.5560d0. Left remaining parameters at existing values:

```
glas_osc_rate = 1.000000025000001d0
sc_osc_rate = 0.99999998864727d0
tdelay_digtzr = 0.00001511d0
plTbias = 0.0000d0
d_plRbias = 0.000002d0
tracker states = 0, 1, 2
instrument_state = 2147483647
```

- CR0000287 : Change Some Values in ElevMgr to use Max Peak

Changed the following to use max\_amplitude peak instead of last peak:

```
GLA06%d_isRngOff = d_rngMaxPkS
GLA06%d_siRngOff = d_rngMaxPkS
GLA06%d_ocRngOff = d_rngMaxPkS
GLA12%d_IsRngLast = d_rngLstPkS
GLA06%d_SigmaElv = d_SDlocMaxPkS
```

In call to E\_CalcSlope, used peak width of maxAmp peak.

Checked maxAmp peak sigma for GLA06%i\_SurfRufslpQF, GLA13%i\_SiRufQF, &GLA15%i\_OcRMSqf

- PR0000290 : a\_4s\_1064\_det\_mod has array problems
- PR0000289 : a\_avg\_prof\_mod has array bounds problems
- PR0000288 : a\_bscs\_mod.f90 has a divide by 0 condition

All of the above fix various FPE and array overflow problems in various pieces of the upper-level atmosphere code.

- PR0000292 : Remove Higher-level atmosphere output time consistency check

Due to a known error in atmosphere buffering, there are several instances where upper level atmosphere products will fail the new output time consistency check (ie: verify time does not go backwards). Since this will impact our processing, we have temporarily removed the consistency check for the upper level products until atmosphere code can be fixed.

#### **5.4.9 GSAS v3.4.1 Release Notes**

GSAS 3.4.1 is a very-minor release which will not terminate upon the detection of backwards time. The new algorithm prints a warning, deletes the bad record, and continues processing. This functionality is build into all the PGEs. This change was necessary because there are several (previously unknown) ways in which a backwards time can occur.

##### **Release Information**

The ClearCase label for this release is RELEASE\_3.4.1.

The release date is April 09, 2003.

All major PGE version numbers have been updated to "V3.4.1 April 2003."

This should be verified during operation by checking the version information in the appropriate ANC06 files.

A new version of the ANC07\_00 data file is required:

##### **Product Changes**

No product sizes or content were changed.

The latest product formats/descriptions will be available at

[http://glas.wff.nasa.gov/v34\\_products/](http://glas.wff.nasa.gov/v34_products/).

##### **Detailed Change Notes**

##### **CR0000318 : Investigate backwards time problems**

The investigation found at least two different problems: the first being a duplication of the firecmd/fireack times in two successive APID19 packets; the second being a 1secondslip in GPS time when GLAS was not earth-pointing.

In light of this, we decided to flag backwards time and delete the affected record. We should watch the ANC06 files and investigate strange occurrences.

#### **5.4.10 GSAS v3.4.2 Release Notes**

GSAS 3.4.2 is a minor release which contains fixes for L1A, Waveform, and Elevation processes and products. There was also a small change made in the Atmosphere processing constants.



For L1A, the following changes were made:

A new check was coded to add the rollover value when the FTLatch has rolled on the previous PDS, but the fire\_cmd\_time has not yet rolled. This fixes a potential time problem. (This affects time on potentially all products)

Added the sample EDOS construction record viewer to the distribution (src/prod\_util/constr\_rec). (No affect on products).

Fixed GLA04 IST and LRS problems with time\_tags which could have caused a time inconsistency. (GLA04 IST and LRS granules)

Modified the GLA02 product format such that i\_et\_acqset\_tm size is consistent with GLA03. (GLA02)

Fixed a reported problem with the GLA04 i\_bst2\_recctr variable. It was not correctly being checked for an unsigned condition. (GLA04 BST)

Some APID21 variables (i\_PDUPMonCal1, and i\_PDUPMonCal2) were found to be incorrectly converted when compared with the GLASIST software. The conversion routines were corrected. (GLA03)

For Waveforms and Elevation, the following changes were made:

Fixed problem where SolAng was not being calculated if PAD is unavailable. (GLA06, GLA12-15)

Fixed problems with d\_reflctUncorr, d\_reflCor\_atm, d\_srf\_ruf, and d\_srf\_slope. (GLA05, GLA06, GLA12-15)

- d\_reflctuncorr – defined
- d\_reflcor – defined for GLA06, GLA12-15 –before only in GLA05
- d\_srf\_ruf and d\_srf\_slope being calculated now –GLA06, GLA12-15

Fixed an averaging interval problem with GLA06,12-15 QAP files. (No products affected)

Fixed a problem where solution sigmas might not be handled properly when peaks are combined or removed during the fitting process. (GLA05 and parameters calculated from them on GLA06, GLA12-GLA15)

Changed the maximum number of peaks to fit (on other-than-land processing) to 2.

Changed minimum interval between peaks (on other-than-land processing) to 20 ns.

For Atmosphere, the following changes were made:

- Changed the default 1064 calibration constant to 5.82d1
- Set a flag indicating that the software use the default 532 calibration constant.
- Set a flag indicating that the software use the default 1064 calibration constant.

Other, more general fixes include:

- Fixed problem where all ANC files did not show up in the product headers. (Affects all product headers)

### **Product Format Change Summary**

On GLA06, 12-15 : the Prod Units of i\_reflCor\_atm changed from "N/A" to "Unitless\*1E06" and the Alg Units from "N/A" to "Unitless. Also changed the Alg Scale from "1" to "1.0d-06".

On GLA06,12-15, bit 4 of i\_corrStatFlg now indicates the method used for calculating roundtrip atmosphere transmission.

On GLA02, i\_et\_acqset\_tm was changed to be an i\_spare6. The variable i\_spare3 i1b(3) was changed to i\_spare3 i1b. The variable i\_et\_acqset was added after the i\_spare3, and was changed to an i2b.

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v34\\_products/](http://glas.wff.nasa.gov/v34_products/).

### **Release Information**

The ClearCase label for this release is RELEASE\_3.4.2.

The release date is April 24, 2003.

Version numbers have been updated to "V3.4.2 April 2003" for the following:

libl1a  
libprod  
libwf  
libelev  
GLAS\_L1A  
GLAS\_Alt  
anc07\_00  
anc07\_02  
anc07\_04

This should be verified during operation by checking the version information in the appropriate ANC06 files.

### **Detailed Change Notes**

- CR0000374 : Change Max number of peaks and interval between peaks for other the land

The two changes are as follows:

```
# Max number of peaks to fit - other than land parameters
#
I_MAXFIT2 = 2
#
```

used to be set to 6; forces no more than 2 Gaussians to be fit for the standard parameterization

```
# Min interval between peaks
#
D_INTV_MIN2 = 20.0d0
#
```

used to be 5.0 forces minimum Gaussian spacing to be 20 ns (between centers of peaks)

- CR0000373 : Change 3 constants in the anc07\_001\_01\_0002.dat file

The constant GD\_IR\_LMCALCOF was changed to 5.82d1.

The constant GI\_USE\_GCC\_F was changed to 0.

The constant GI\_USE\_IRCC\_F was changed to 0.

All three constants reside in anc07\_001\_01\_0002.dat

- CR0000362 : Fix shot\_time to account for hidden FTLatch rollover

Added detection code to shot\_time\_mod which compares the first FTLatch against the first shot\_time. If the FTLatch is a half-rollover value less than the shot\_time, the rollover value is added to the FTLatch in all ANC32 records.

- CR0000354 : Add the construction record viewer to GSAS distribution

Added to /glas/vob/src/prod\_util/constr\_rec. Created makefile and added to distribution script.

- PR0000347 : GLA04 IST Problems

1) last\_ist\_vtcw and last\_lrs\_vtcw should be global variables in L\_Att.

2) The time tag estimation code (where the VTCW does NOT roll within the frame but the time\_tag does) was changed to subtract 1 from the time\_tags starting at the point of the time\_tag roll and continuing backwards to the first time\_tag.

The previous algorithm (using deltas) covered up the IST problem with duplicate data.

- CR0000341 : Change i\_et\_acqset\_tm on GLA02 from i1b to i2b

Changes were made to GLA02\_scal\_mod, GLA02\_prod\_mod, GLA02\_alg\_mod. The variable i\_et\_acqset\_tm was changed to be an i\_spare6. The variable i\_spare3 i1b(3) was changed to i\_spare3 i1b. The variable i\_et\_acqset was added after the i\_spare3, and was changed to an i2b.

- PR0000327 : i\_bst2\_recctr calculation incorrect in L\_Att\_Proc

On line 365 or there about in L\_Att\_MOD.f90,

if (GLA04\_bst\_alg%i\_bst2\_recctr(i)) &

was changed to

if (GLA04\_bst\_alg%i\_bst2\_recctr(i) < 0)

- AI0000324 : Compare GLA03 data to PJ APIDoutput

An error was found in an equation used in APID21. The code in /glas/vob/src/l1a\_lib/L\_Eng\_mod.f90 was modified to correct the inputs to the first equation used in APID21 around line 464 to check for unsigned on i\_PDUPMonCal1, and i\_PDUPMonCal2.

- PR0000302 : All ANC files do not show in product headers

All input ANC files were not showing in the product headers. This is because the files are included by comparing the file start/stop time against the granule start/stop time. In the control file, many ANC files have start/stop times of 0/0. A file whose start/stop times is 0/0 is now considered as an input to the granule.

- PR0000321 : Some GLA06, 12-15 Variables Are Incorrect
- PR0000319 : QAP06,12-15 incorrect for Release 9

Added code in ElevMgr to get d\_reflctUncorr from gla05, to calculate d\_reflCor\_atm, and to pass these values to gla12-15. In previous releases, d\_reflctUncorr and d\_reflCor\_atm were undefined on gla06, 12-15.

Added d\_T\_RTatm to const\_elev\_mod and anc07\_0003 as the default round-trip atmosphere transmission used to compute d\_reflCor\_atm.

$d\_reflCor\_atm = d\_reflctUncorr / d\_T\_RTatm$

(d\_T\_RTatm = the round-trip atmosphere transmission)

$d\_T\_RTatm = \exp(-2(Tc+Ta+Tm))$ , where

Tc is the cloud (column) integrated optical depth (1/sec),

Ta is the aerosol (column) integrated optical depth (1/4sec),

Tm is the molecular optical depth.

The optical depths are not available until GLA11, so per Steve Palm, the approximation to use for d\_T\_RTatm is 0.98.

Added pass through in WFMgr for d\_beam\_coelev, d\_beam\_azimuth, and d\_SolAng. Added code to WFMgr & ElevMgr to calculate d\_SolAng if ephemeris is available even if PAD is not available. Checking for first valid lat, lon, elev to use for the calculation. In previous releases, d\_beam\_coelev, d\_beam\_azimuth, and d\_SolAng were undefined.

Changed initialized value of `i_sigmaatt` from 0 to `gi_invalid_i2b` in `GLA05_prod_mod` & `GLA06_prod_mod`.

The attitude quality indicator (`i_sigmaatt`) is obtained from `anc09` (PointingSigma). `i_sigmaatt` was not being scaled from PointingSigma correctly. In previous releases, `i_sigmaatt` will be 0 because of this error.

Changed code in `ElevMgr` so that the 100 km averages will be done over the correct time interval. In previous releases, where there were data gaps, all of the averages may not have been computed and written to `QAP06`.

Changed `ElevMgr` to use the peak with the maximum amplitude instead of the last (closest-to-the-ground) peak for calculating slope & roughness, and setting `i_SurfRufslpQF` & `GLA15%i_OcRMSqf`.

- PR0000308 : GLA05 Solution Sigmas For Some Peaks Are Incorrect
- PR0000294 : Using DEBUG mode, Waveform developer should be able to run dataset without crashing.
- PR0000225 : The transmitted pulse is not being fit when there is no received WF.

The solution sigmas were not being handled properly when peaks were combined or removed during the fitting process. They are now being set invalid for invalid peaks. When peaks are removed during the fitting process, the corresponding solution sigmas are also removed. In previous releases, when the amplitude or peak-width became too large during the fitting process, that shot was marked as a poor fit, and the peak parameters were estimated, but nothing was done to the solution sigmas (which no longer corresponded to `i_parm`). With this release, when either the amplitude or peak width become too large during the fitting process, the solution sigmas are re-initialized, an estimate for one peak is made, and the fitting process is restarted generating new solution sigmas. Only those solution sigmas that correspond to non-invalid parameters are now stored on the product. The transmitted pulses are now being fit whether there is a received WF or not. The transmitted pulse characteristics are now being initialized, so that if there is no transmitted pulse, a random number does not cause an overflow or underflow when being scaled before writing to the product.

#### **5.4.11 GSAS v3.5 Release Notes**

GSAS 3.5 is a semi-major release which contains fixes and adds significant functionality for L1A, Atmosphere, Waveform, and Elevation processes and products. Additionally, NOSE functionality was incorporated into `GLAS_Meta`.

For L1A, the following changes were made:

A check provided by the instrument team was insufficient to filter base `GLA04` IST COIs. We revised the check to compare the absolute value of the COI to a pre-defined limit. (`GLA04-04`)

We fixed significant problems with the GLA04 IST and LRS flags (i\_ist\_flag,i\_lrs\_flag). The flags were not initialized correctly, causing bad values to be written to the product. (GLA04-04)

Code was added to L\_Alt to compute the differences between the 40 fire\_ack and fire\_cmd times. A new flag was added to GLA01 which indicates that this difference is out of limits. This is a product change on GLA01 and is described later in more detail. (GLA01)

GLA04 QAP files are now generated. (GLA04) • GLAS\_L0proc now uses the EDOS construction record to detect (and avoid) EDOS-filled packets. (GLA01-GLA04)

Waveform scale factors have been put in the GLA01 header records. (GLA01)

Changed the background subtraction level for the droop correction routine from 54.0 to 54.4, based on offline testing of the droop correction routine. (GLA02)

For Waveforms and Elevation, the following changes were made:

The threshold level to decide where the signal region was in the waveform was raised from 4.5 to 8.0 times the standard deviation of the noise. This edited out-most of the noise-only signals that were present in previous releases.

The minimum Gaussian sigma allowed for the received waveform was raised from 0.5 ns to 2.5 ns. Gaussian fit to the transmit pulse varied slightly over the measurements, but the minimum value was 2.5 ns. Therefore physically we could not get a received signal that was narrower. This change stopped some of the problems seen fitting forward scattering type waveforms where the first Gaussian was very narrow and did not fit to the full ground return, so the second Gaussian spread out fitting to the forward scattering portion and some of the ground return. This caused the elevation measured using the max peak to be too high. (GLA05)

Corrected W\_Assess\_mod to not calculate the elevation if there is no signal.

Range Offset was added to GLA12-15. (GLA12-15)

Fixed implementation of attflg, elvuseflg, altfrmfflg, orbflg and corrstat-flg. (GLA05, GLA06, GLA12-15)

For Atmosphere, the following changes were made

GD\_TIME\_TOL (in file anc07\_001\_01\_0002.dat) was changed from 1.0d0 to 1.0d2 in order to resolve problems running GLAS\_Atm which is very sensitive to the ANC36 granule boundary times. (GLA07-11)

Changes were made to the routines that find cloud layer heights using the 1064 (cloud digitizer) channel data. Prior version had a bug where the bottom of the layer was not defined. This is fixed. Also, modified algorithms to reduce the number of false positives. (GLA07-11)

A bug was fixed in AtmMgr\_mod.f90 which caused errors when run in DEBUG mode. Subsequent analysis and testing of code revealed that the calculated value of the variable "i\_buff\_limit" was becoming too large. (GLA07-11)

Other, more general fixes include:

Re-fixed problem where all ANC files did not show up in the product headers. (Affects all product headers)

Implemented NOSE support into GLAS\_Meta. This requires that GLAS\_Meta read the data from the product files, but is quick enough that it shouldn't be a burden on operations. Fixed minor metadata issues. (Affects all product headers and.MET files)

### **Product Format Change Summary**

On GLA01, a new 5-byte flag (i\_TxFlg) was added. Bytes were taken from spares so the product size did not change.

On GLA06, 12-15 : replaced i\_SigBegOff with i\_isRngOff in GLA12: i\_siRngOff in GLA13: i\_ldRngOff in GLA14: i\_ocRngOff in GLA15: propagated from GLA06.

The latest product formats/descriptions will be available at:

[http://glas.wff.nasa.gov/v35\\_products/](http://glas.wff.nasa.gov/v35_products/).

### **Release Information**

The ClearCase label for this release is RELEASE\_3.5.

The release date is May 16, 2003.

Version numbers have been updated to "V3.5 May 2003" for the following:

libl1a

libprod

libanc

libplatform

libwf

GLAS\_L0proc

GLAS\_L1A

GLAS\_Meta

anc07\_00

anc07\_01

anc07\_02

anc07\_04

anc07\_05

This should be verified during operation by checking the version information in the appropriate ANC06 files.

#### ANC Files

New versions of the ANC07\_00, ANC07\_01, ANC07\_02, ANC07\_04, and ANC07\_05 data files are required. New version of the ANC45 files are required.

#### Construction Records

Construction records should be input to GLAS\_L0proc. Construction records should be renamed exactly as the GLA00 files, except using "ANC47" instead of "GLA00" as the file id.

For example : GLA00\_003\_20030328\_120000\_01\_0013.DAT  
and ANC47\_003\_20030328\_120000\_01\_0013.DAT

#### GLA04 QAP.

GLA04 qap files should be outputs in GLAS\_L1A.

#### Version information on the INPUT\_FILE/OUTPUT\_FILE specifications

ALL GLAS\_L0proc/GLAS\_L1A/GLAS\_Atm/GLAS\_Alt GLA PRODUCT  
INPUT\_FILE and OUTPUT\_FILE control lines should follow what is defined in the GSAS User Guide.

INPUT\_FILE=file\_name<sp>start\_time<sp>stop\_time<sp>gran\_rel\_num<sp>gran\_ver\_num<sp>gran\_segment

OUTPUT\_FILE=file\_name<sp>start\_time<sp>stop\_time<sp>gran\_rel\_num<sp>gran\_ver\_num<sp>gran\_segment

See Page 5-4 of the GSAS User Guide for more information.

#### PASSID

Passid Lines are now critical for all control files including GLAS\_Meta.

#### Detailed Change Notes

- CR0000374 : Change Max number of peaks and interval between peaks for other the land

The two changes are as follows:

```
# Max number of peaks to fit - other than land parameters
#
I_MAXFIT2 = 2
#
```

used to be set to 6; forces no more than 2 Gaussians to be fit for the standard parameterization

```
# Min interval between peaks
#
```



```
D_INTV_MIN2 = 20.0d0
#
```

used to be 5.0 forces minimum Gaussian spacing to be 20ns (between centers of peaks)

- CR0000406 : anc07--004 change to wf parameterization

Make the following changes in anc07\_001\_01\_0004.dat : maxfit2 =2; cmb2=1; nsig2=8.0; sigmaminit=2.5; int\_min2=20.0.

- PR0000404 : IST ( GLA04-04 ) Bad data flagging

UTCSR has found that some IST data that GSAS has aligned is bad. They eliminate this when they edit by COI > 0.105. They also report some data from PRAP has not made it to GLA04. However it appears from the UTCSR emails (see additional information) that they should have. Investigation is required to see if there is a code improvement needed or if the results are proper and need to be documented.

Two different problems were found and fixed:

- 1) The test for the bad COI defined in the previous Mantis entry was insufficient. The ABS (limit) should be tested.
- 2) The IST and LRS flags were not initialized correctly.

- CR0000400 : change anc07...004 parameters for wf standard tuning

From rel 10, the changes are: int\_min2=30.0; nsig2=8.0; sigmaminit=2.5; cmb2=0.0

- PR0000397 : Product headers only use information from ANC4501

The product headers are currently using only information for ANC4501. This caused a problem when testing for NOSE implementation.

- PR0000389 : ANC20 not processed because longitude tolerance exceeded

The ANC20 files for May 21-24 were not being processed because a matching track could not be found in the 8 day reference orbit file. There was a maneuver inserted in the ANC20 file which caused the displacement of more than 0.015 degs longitude. The code was fixed in the ops baseline by increasing the tolerance to 0.03 degs. Another error was introduced by this maneuver which cause the cycle to be incorrectly calculated.

- PR0000386 : GLA05 elevation needs to be set invalid when no signal for standard parameterization

Currently when there is no signal the elevation for GLA05 is calculated using the reference range and when there is a signal it is calculated using the location to the end of signal. This needs to be changed so that if there is no signal using the standard parameterization then the elevation on GLA05 is set to invalid. However the orbit and attitude should still be calculated. Make sure that if the standard parameterization gives no signal but the alternate finds a signal that GLA14 has a valid elevation and location.

Corrected W\_Assess\_mod to not calculate the elevation if there is no signal. GLA05%*d\_PADPoint* is still obtained from *gd\_lasICRF* in WFMgr if there is an anc09. GLA05%*d\_PODFixedPos* is set invalid if the waveform is invalid, or if there is no transmitted pulse, or if the reference range is invalid, or if there is no signal (both std & alt). The standard parameterization is used for the preliminary range offset unless there is no signal (std). In that case, the alternate parameterization is used. GLA05%*i\_elvFlg* indicates which was used.

- CR0000383 : GLA09 cloud heights from 1064 cloud digitizer data

The algorithms for cloud detection using the 1064 cloud digitizer channel must be refined. Changes made for V3.5 greatly increased accuracy and reliability of cloud heights. Further changes may be necessary.

- CR0000379 : anc07 constant GD\_TIME\_TOL must be changed

The constant GD\_TIME\_TOL must be changed from 1.0d0 to 1.0d2 to avoid time gap problems in anc36 files.

- CR0000378 : transmit pulse problem

Sometimes the transmit pulse is not telemetered in the transmit pulse location, but a different pulse and the time is then totally wrong causing the measurement to be off by meters to 10s of kilometers. To edit out this data, we need to check the difference between the fire ack - fire command time (see below) and then mark the data as invalid.

Difference these (fire ack - fire command) and if it is less than 195 usecs or greater than 205 usecs, then whatever is in the transmit pulse window is NOT a transmit pulse. If it is greater than 205 you will like see tiny blips or just noise. If it is less than 195, you will either see noise or a giant weird pulse, it is either the delay line or just the detector response to the gain changing to prepare for the return pulse. Either way, it is NOT the start pulse.

On GLA01 at the end of the main record is *i\_spare2*. There needs to be a new *i\_TxFlag* of 40 bits (5 bytes) and *i\_spare\_2* reduced to 15 bytes so total record length is not changed. The new *i\_TxFlag* is set to invalid for either of the above cases, otherwise it is set to valid.

- PR0000372 : saturation flag needs to be set based on new criteria

The saturation flag in *wfqual* needs to be set based on new criteria defined by Xiaoli. Currently it is set based on the counts being  $\geq 230.0$  New algorithm: (Gain = 13) AND (pulse amplitude exceed 220) AND (Echo pulse energy > (15fj) ).

- PR0000366 : Problems reading ANC36 file

Several SDMS jobs failed with the following error:

```
48291460 STATUS= 10005, 0, OpenFInFile, Opened file:
(Input)ANC36_009_11_02002_0027_0_01_0001.DAT
```

48291460 ERROR=-10008, 3, read\_atm\_cc, Error Reading File: Error reading atm calc of data

- CR0000342 : GLA13 does not have sea ice range offset

The problem in this bug has been combined with mantis entry 0000340.

- CR0000340 : GLA12, GLA13, GLA14, and GLA15 do not contain the range offset used to calculate the elevation on the product

The elevation is calculated on GLA12, GLA13, GLA14, and GLA15 using the ice sheet, sea ice, land, and ocean range offsets respectfully. However the corresponding range offset is not present on the product so cannot recalculate the elevation using a different offset. On each of these products, we need to replace the i\_sigbegoff with the appropriate range offset. on GLA12 replace i\_sigbegoff with i\_isrngoff on GLA13 replace i\_sigbegoff with i\_isrngoff with the appropriate range offset.

on GLA12 replace i\_sigbegoff with i\_isrngoff

on GLA13 replace i\_sigbegoff with i\_isrngoff

on GLA14 replace i\_sigbegoff with i\_ldrngoff

on GLA15 replace i\_sigbegoff with i\_ocrngoff

Change the corresponding product variables and request changes in the parameter database defining the product

In elevmgr these 4 offsets are defined and placed in GLA06 variables. Use the GLA06 variable name when you define them,

i.e. GLA12%d\_isrngoff=GLA06\_isrngoff etc.

- AI0000339 : Move W\_Add2Hst\_mod.f90 to common

W\_Add2Hst\_mod.f90 is used by qapg and should also be used by the elevation code to compute histogram bins.

It is located in src/waveforms/W\_Common.

It should be moved to src/common\_libs, possibly in math\_lib.

- AI0000337 : Enable GL0P to parse the PDS/EDS Construction Record

This code breaks every rule we have. It is mostly written in C, given that the structure of the construction records cannot be coded efficiently in Fortran. It also allocates memory in both Fortran and C and reads the entire construction record into core.

SDMS should now provide ANC47 files as inputs to GLAS\_L0proc. ANC47 files should be named exactly as GLA00 files, with "ANC47" replacing "GLA00". Failure to provide a construction record as input will elicit a sanity check warning. Not much can be done to determine if the correct version of the construction record is provided with the correct version of the APID.

- PR0000323 : Some GLA06, 12-15 Flags Are Incorrect

All discernible problems with these flags were resolved on branches pr323 and wpr323, involving modules for ElevMgr\_mod, WFMgr\_mod, anc08\_mod, and anc09\_mod.

Some of the reported problems with anc08 and anc09 were due to partial miscommunications between the originators of the data and the local programmers utilizing the data, though these seem to have been satisfactorily resolved.

Some of the reported flag problems could not be verified. This might be because the problems did not occur in the available sample data used for analysis and testing, or possibly because documentation of the problem was insufficiently precise to locate the problem; therefore, scrutiny of all flag values should continue in future software builds.

- PR0000291 : Using DEBUG mode, Atmosphere developers should fix code till it runs test set without errors

Developers should test with the following dataset. The code should be tested until it runs without error.

The data are on gladev.wff.nasa.gov in /glasdev1/flight\_data/atm\_20030222.

- CR0000150 : Place scaling factors into GLA01 header records

Waveform raw counts needs to be converted to a floating point number based on a 0 to 255 table (anc07) lookup both in L1A and L1B. All computations on waveforms will be done on these re-scaled values. The raw will still be on the Gall product. The waveform lookup table needs to be in the GLA01 header record(s). Wrong track point and energy.

GLA01\_hdr\_mod significantly enhanced and modified to write the gain\_table and volt\_table's data from const\_glob into the GLA01 header as the file is created. Involves a minor addition to const\_glob module. Modifications made on branch wcr150, using much of the existing keyval software and structures. This is first mod that adds "local" header records in addition to the "common" header records found on all products. Size of header data is enhanced from 1 to 6 records with this addition. Although no provision exists for reading the noted tables of data backwards from the header into storage, the "read" software module with the GLA01\_hdr\_mod was changed to show how this process can be done.

- AI0000134 : Move onepass\_avg\_mod.f90

onepass\_avg\_mod.f90, which implements the Kahan algorithm for one-pass averaging, was written as part of the qap generator.

It is needed elsewhere and should be moved to the math lib archive.

- AI0000101 : Implement Selective NOSE Metadata
- AI0000098 : Interfacing the NOSE Routines with GSAS

NOSE routines were added into GLAS\_Meta. This requires that GLAS\_Meta re-read the product data, but in practice, this has been a fairly quick process.

- AI0000094 : QAP Mod for GLA04

QAP support has been added for GLA04.

### **GSAS v3.5 Errata**

After GSAS v3.5 was delivered, a decision was made to change waveforms parameter `int_min2` to 30. This was done before any GLA05 products were released.

Additionally, a bug was found in the `i_surftype` flag where the bits are set opposite what is documented. As coded (and currently on the products), here is the interpretation of the bits.

Bit 0 - Ice Sheet (least sig. bit)

Bit 1 - Ocean

Bit 2 - Sea Ice

Bit 3 - Land

We will fix the code to match the documentation in the next release.

### **5.4.12 GSAS v3.6 Release Notes**

GSAS 3.6 is a major release which contains fixes and adds significant functionality for L1A, Atmosphere, Waveform, and Elevation processes and products. Additional functionality was incorporated into GLAS\_Meta.

For L1A, the following changes were made:

Updated GLA01 to match new CCR-006 telemetry formats.

Fixed possible duplication of L1A records at granule seams.

Added laser / detector sensitivity to energy calculations i.e. allowed different calibration constants depending on which laser or detector is on.

GLA04 BST time computation now uses data latency.

Fixed a problem where GLA01 `i_gainSet1064` was not being correctly handled as an unsigned value.

For Waveforms, the following changes were made:

Standard fit fine tuned to fit leading edge better

Previous releases were processing returns which had no leading or trailing edge. For release 12, these measurements will not be processed since there is no way to accurately calculate a valid range if the return walked off the front or back of the telemetered window.

Standard fit requires minimum of 30 ns between peaks –merges peaks closer than this into same Gaussian

Standard fit uses observed values of noise and corresponding standard deviation to calculate threshold for signal instead of calculating the noise from the waveform – causes some “bad” returns to be processed compared with release 3.5

Error fixed that caused many good waveforms to not have fits in release 11 (3.5).  
All good near-Gaussian returns appear to have Gaussian fits

Significant improvement in saturated WF fits

Flags added to mark separately high and low gain saturation

Flag added to mark high gain saturation with large amount of forward scattering based on waveform shape, gain, and amplitude only, not measured atmosphere

Bug fixed that caused negative sigma values

Wfqual flag corrected – should agree with documentation

Received energy all, is now calculated from all energy above the threshold instead of just from the maximum peak – this will affect reflectance.

The transmitted energy is now calculated for each shot when calculating reflectance in W\_Assess.

The high frequency GPS time correction, beam co-elevation, and beam azimuth values on release 11 (GSAS 3.5) were truncated at 0 instead of allowing them to go negative – this was fixed. The GPS time correction was used correctly internally (in Release 11) so the orbit interpolation was still at the correct time.

Transmit waveforms are now being fit where before they were not due to a too stringent check on the width. – did not affect range measurement because that was based on the centroid and not the Gaussian fit.

Computational problem corrected in GLA05 which prevented negative values from appearing in the deltagpstmcor, beam\_azimuth, and beam\_coelev values. As these values are pass-throughs to GLA06 and 12-15, the problem also appeared there.

For Elevation processes, the following changes were made:

Tidal values – The tidal values on release 11 products (GSAS 3.5) were applied with the wrong sign. They were also applied to the slant range before the elevation was calculated. Release 12 (GSAS 3.6) now calculates the elevation without correcting the range for the tides and then applied them to the resultant elevation with the correct sign.

The specific range offset used to calculate the elevation on each region l2 product is output on the product.

Flags fixed – should reflect documentation (surface flag is now in the correct order)

Saturation and forward scattering flags brought forward to elevation products in rng\_uqf

Saturation flag removed from elvflg – put in rng\_uqf

The troposphere correction is now corrected for off-nadir attitude and new coefficients were used in the calculation – should see very minimal (mm) differences due to coefficient change. For larger off-nadir attitudes will see cm differences due to slant range correction

Reflectance changes:

- optical transmission change from .555 to .67 based on BCE measurements and analysis of reflectance – reflectance values will change accordingly
- reflectance now calculated using individual transmit pulses instead of one transmit pulse/sec – did not remove oscillation but changed values slightly

The units on GLA12-15 for the standard deviation of the fit to the data did not allow for enough significant digits, they have been changed to millivolts.

The slope and roughness are no longer invalid for the narrow returns. The equation to calculate these use the sigma of the impulse response and this was incorrectly input as 4 ns instead of the 1.7 ns used in release 12.

For Atmosphere, the following changes were made:

The atmosphere calibration file was modified to handle larger values/more precision.

Other, more general fixes include:

Several flag definitions were changed/updated.

Production documentation was updated/fixed.

Significant changes were made to the browse products.

Metadata files were updated to work with ESDT changes.

QAP processing was enhanced.

### **Product Format/Definition Change Summary**

GLA01:

Updated to match new GLAS Flight S/W CCR-006 telemetry formats. The GLA01 format for the short and long record has been changed. The record length is the same but the spares at the end of the records now contain gainStatus, NumCoinc, rawPkHt.

Correction made to i\_instState PDF, bit 19, changing Primary to Secondary. Change the product database for GLA01\_Main, i\_instState, invalid=i4b to invalid=no.

GLA01, GLA04\_01

i\_txWfPk\_Flag documentation has been corrected.

GLA04\_05

variables i\_bst1\_BG and i\_bst2\_BG have been updated to: Unsigned = No, Prod Min = -32767, Prod Max = 32767.

variables i\_bst1\_datlat and i\_bst2\_datlat. Prod Units chg to Microseconds and Alg Scale chg to 1.0D-6

#### GLA05

i\_MaxRecAmp, product units=Tenth of millivolts, algorithm scale= 1.0d-4

variables i\_gval\_tx and i\_gval\_rcv were changed to invalid value "NO"

Changed bit definitions in wfqual on GLA05

Changed descriptions of i\_parm1 & i\_parm2

#### GLA05, 06, 12-15

i\_MaxSmAmp, product units= Tenth of millivolts, algorithm scale= 1.0d-4

i\_refltuncorr now a common parameter

PADPoint description has been modified

#### GLA06, 12-15

Changed i\_corrStatFlg from (2) to (3) on gla06, 12-15. Defined a bit in i\_corrStatFlg to indicate that a default value for the optical depth was used to calculate the atm correction to the reflectance.

Removed the saturation bit from elvflg (bit 7). Put saturation bit info into i\_rng\_UQF on GLA06 and GLA12-15.

#### GLA12-15

GLA12:i\_IceSVar, GLA13: i\_SeaIceVar, GLA14: i\_LandVar, GLA15: i\_OceanVar have been updated with the Prod Units: millivolts, Alg Units: volts, Alg Scale: 1.00E-03 and new description.

Specific range offsets used to calculate elevation put on each product replacing signal end.

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v36\\_products/](http://glas.wff.nasa.gov/v36_products/).

#### Known Problems

Release 12 made significant improvements in fitting the Gaussians to the return for the standard parameterization when the return was not significantly spread due to slopes or roughness. However, wide noisy returns may now have worse fits than for release 11. When the fit is bad the roughness and slope calculated from it are erroneous. On each of the higher level elevation products there is a variable that gives the standard deviation of the functional fit to the raw waveform. The variable names are: GLA12- i\_IceSVar; GLA13-i\_SeaIceVar, GLA14-i\_LandVar, GLA15-i\_OceanVar.



When these values are larger than normal, it infers that the functional fit does not fit the waveform well and therefore the slope and roughness calculations are suspect.

For narrow waveforms, the slope and roughness are undefined even though the Gaussian fit is good.

GLA04 QAP is not processed.

GLA16 is still not ready for production.

Elevation processing must still include ANC08 and ANC09 as inputs.

Due to some data errors on GLA04\_05, more records are now being deleted due to overlapping (or exact) times.

The Ball Star Tracker time tag algorithm was modified to correctly use the internal time tag. Normally this is .12xxx seconds; however whenever there are duplicate data the time tag is .22yyy. This can yield exact duplicate time or an approximate duplicate time to the millisecond level. The duplicate time edit is currently on an exact time repeat so the cases of millisecond differences are not edited.

### **Release Information**

The ClearCase label for this release is RELEASE\_3.6.

The release date is August 28, 2003.

Version numbers have been updated to "V3.6 August 2003" for the following:

- all libraries

- GLAS\_L1A

- GLAS\_Alt

- GLAS\_Atm

- GLAS\_Meta

- anc07\_00

- anc07\_01

- anc07\_02

- anc07\_03

- anc07\_04

- anc07\_05

- anc45\_01-15

This should be verified during operation by checking the version information in the appropriate ANC06 files.

### **Detailed Change Notes**

- AI0000102 : Create a Utility to put GLA16 in HDF Format

Modified ANC45 files to be more consistent with NSIDC MCF files.

Modified File I/O routines to accept ANC48 and ANC49 (MCF files).

Modified I/O routines to accept GLA16.

Renamed toupper.f90 to gsas\_toupper.f90 to avoid a name space collision with HDFEOS. Changed all routines which called toupper.f90 appropriately.

Added StartOrbitNumber and StopOrbitNumber to common\_hdr\_mod. Commented-out constant NOSE start/stop blocks. Revised instrument\_state change code.

Added "type=None" capability to openinfile and openoutfile.

- PR0000199 : GLAS\_Alt elevations crashes when running with certain control settings

Checks were added to the code so as to error gracefully if there is a problem with the ANC04 file.

- AI0000252 : BST background conversion incorrect?

From the science team: The background count should be treated as signed. A negative count means that the tracker has been light saturated for a longer period of time and because the reference voltage is dynamic, can result in a negative output-this data can be ignored but nonetheless recorded as such.

Code was changed to reflect that the BST background count is a signed number.

The product database documentation for GLA04-05, variables i\_bst1\_BG and i\_bst2\_BG has been updated to: Unsigned = No, Prod Min = -32767, Prod Max = 32767 and the Comment was added from Paul Woznick: The background count should be treated as signed. A negative count mean that the tracker has been light saturated for a longer period of time and because the reference voltage is dynamic, can result in a negative output.

- PR0000265 : Fitted peak width is occasionally negative

In W\_LsqFit\_mod, the fitting process occasionally recommends a negative peak sigma.

- PR0000296 : GLA05 QAP Problems in Release 9

The following has been done:

- 1) spare01 is now set to gi\_invalid\_i4b.
- 2) W\_GetAsQAStats was being called in the wrong order in W\_CreQAStats\_mod
- 3) W\_BuildTrkStats was being called in the wrong order in W\_CreQAStats\_mod
- 4) i\_hstnInitPks(:,2:5) are now set.

- 5) dQA\_100DCent & iQAhtDeltaCnt now use the maxAmp peak instead of the last peak.
- 6) limits for i\_hstDeltaCnt have changed from [0,100] to [-50,50]
- 7) limits for i\_hstNInitPks have changed from [0,6] to [0,50].
- 8) The error near line 1118 in W\_Assess\_mod has been fixed. There might be more places that need fixing for this problem.
- 9) Calculations for i\_pcmtNoFit, i\_pcmtNoSig, & i\_pcmtXSat now use NINT.

- CR0000349 : Define Another bit in i\_corrStatFlg

Defined a bit in i\_corrStatFlg to indicate that a default value for the optical depth was used to calculate the atm correction to the reflectance.

Changed ElevMgr to set i\_corrStatFlg(3) (stored as bit 4 on products), and to pass i\_corrStatFlg through from GLA06 to GLA12-15.

Changed i\_corrStatFlg from (2) to (3) on gla06, 12-15.

Changed funpk\_CorrStatFlg & fpk\_CorrStatFlg to handle (3).

- AI0000359 : Change Documentation for i\_corrStatFlg on gla06,12-15

Changed i\_CorrStatFlg, algorithm dimension from 2 to 3. Changed the PDF of i\_CorrStatFlg by adding bit 4 with new definitions.

- CR0000369 : sigma att definition inconsistent with documentation and code

Code now matches documentation in the ICD and sets sigmaatt flag accordingly using a small finite set of integer flag values rather than a continuum range.

- CR0000370 : dry trope correction needs to have path angle correction included

The trop corrections have been scaled to account for path angle.

- CR0000372 : saturation flag needs to be set based on new criteria

Saturation flag is now set based upon the triple criterion that:

- a) Gain  $\leq 13$
- b) pulse amplitude  $> 220$
- c) echo pulse energy  $> 15$  fJ

- CR0000377 : changes in elvflg to account for saturation and max peak used in ht calc

GLA05 - set bit 7 in elvflg when wfqual saturation bit is set bit 6 everywhere indicating "other" algorithm used to calculate elevation no other bits should be set for GLA05

GLA06, GLA12, GLA13, GLA14

set bit 7 when wfqual saturation bit is set

set bit 5 indicating "Gaussian with largest peak used"

no other bits should be set

GLA14, set bit 1 indicating "centroid for alternate parameterization"

(this should already be set)

set bit 7 when wfqual saturation bit is set

The reference in the previous bug note 5-28-03 should refer to GLA06, GLA12, GLA13, and GLA15 as a group. GLA14 is mentioned below those as a special case.

- CR0000384 : QAPG updates for GLA03,04, Release 10

See Items 419 and 427.

- AI0000388 : check out the coefficients being used by GSAS in trop calculations

The K1, K2 refractive index coefficients were changed to 0.7866385, and 0.6644364 K/bar in the trop correction calculations.

- AI0000396 : Waveforms needs to use new GLA01 Transmit quality flag to detect bad Tx waveform

WFMgr uses GLA01%i\_txFlg (Transmit quality flag) to detect when the transmitted pulse is bad and then sets GLA05%l\_wfQual(gwi\_noTrPulse,:). ElevMgr checks for l\_WFqual(gwi\_noTrPulse,:).

Added check for i\_TxFlg

Added check for l\_WFqual(gwi\_noTrPulse,:)

Added l\_isRecWF (=True when received WF, False when transmitted pulse) to various subroutines so they will check the appropriate l\_wfQual flags.

- PR0000418 : i\_surftype has bits 4-7 set instead of bits 0-3

There were several problems with surftype flag (now corrected); however, the description of the errors in this Bug report were inaccurate. The code had been changed so that the common\_flags modules were bypassed. All scal\_mod modules have been changed and the common\_flags module has been brought up to speed for the surftype flag from antiquated internal code that was in place. There was also a mis-assignment problem by bit in the ElevMgr\_mod.

- CR0000419 : QAPG updates for Gla06,12-15

Comparison of Release 11 and modified results:

GLA06

. Max amp of raw wf a-t data -- d\_maxSmAmp.

The scale factor was changed between Release 11 and now (Mantis 449). The current values are x100 lower than they should be, consistent with this scale change.

. N final peak histograms -- i\_numPk -- differ between QAPG and L2 output GLA12, 14 appear to be the same.

I suspect changes somewhere in the production software constants files between the time of the Release 11 run and the time of the QAPG run.

. Dry trop bar -- d\_dtrop -- and other bars on GLA12-15 have different # points. Some have different values.

I suspect changes somewhere in the production software constants files between the time of the Release 11 run and the time of the QAPG run.

---

#### GLA12

. Max amp of raw wf a-t data -- d\_maxSmAmp: see GLA06.

. N final peak histograms -- i\_numPk -- differ. GLA 12, 14 appear to be the same: see GLA06.

. GLA06 dry trop bar -- d\_dtrop -- and other bars on GLA12-15 have different # points. some have different values: see GLA06.

---

#### GLA13

. Max amp of raw wf a-t data -- d\_maxSmAmp: see GLA06.

. GLA06 dry trop bar -- d\_dtrop -- and other bars on GLA12-15 have different # points. some have different values: see GLA06.

. A-T Surf rough: L2 - no good data. QAPG - good data. How can this happen?

I suspect changes somewhere in the production software constants files between the time of the Release 11 run and the time of the QAPG run.

---

#### GLA14

. Max amp of raw wf a-t data -- d\_maxSmAmp: see GLA06.

. N final peak histograms -- i\_numPk -- differ. GLA 12, 14 appear to be the same: see GLA06.

. GLA06 dry trop bar -- d\_dtrop -- and other bars on GLA12-15 have different # points. some have different values: see GLA06.

---

#### GLA15

. Max amp of raw wf a-t data -- d\_maxSmAmp: see GLA06.

. QAPG is not computing elev wrt ellipsoid for GLA15. Why not? Check the elev code to see if this can be done. If it cannot be done, need to change flag set in qapg\_prodnit.

For now, QAPG\_ProdInit changed to indicate N/A.

. GLA06 dry trop bar -- d\_dtrop -- and other bars on GLA12-15 have different # points. some have different values: see GLA06.

- PR0000426 : In WFMgr\_mod, some WFQual flags are set for every shot but shouldn't be

resolved as part of Item 0000372, based on instructions from L.Roberts and J.Guerber

- PR0000427 : qapg\_gla05\_at.f90 compares logical variables to 0

There is also one place in qapg\_gla05\_sum.f90 where the same logical is compared to 1.

This bug will be fixed on branch PR310, where qapg is being modified to add code to generate qap files for GLA03 and GLA04. See Mantis 384.

- CR0000429 : Alg Structures Should Not Be Accessed Directly In W\_Assess

test results to show that moving required GLA01 and GLA05 variables to calling sequence makes no difference

- CR0000443 : add new keywords to anc09 processing for indexed degradations

Indexed degradations in addition to time-referenced degradations are now processed by software under brnach cr443. ICD modifications have been submitted.

- CR0000444 : Ball Star tracker data latency product scale change

The product database has been updated for GLA04-05, variables i\_bst1\_datlat and i\_bst2\_datlat. Prod Units chg to Microseconds and Alg Scale chg to 1.0D-6.

- PR0000446 : No Fit For Some WFs

Resolved on branch pr471.

- AI0000447 : Update .met processing for new

Updated ANC45 files to reflect ESDT descriptor revisions.

- CR0000448 : product data base scale factor and units wrong for maxrecamp and maxsmamp

In the Product Database changed the following:

GLA05, i\_MaxRecAmp, product units=Tenth of millivolts, algorithm scale= 1.0d-4

GLA05, i\_MaxSmAmp, product units= Tenth of millivolts, algorithm scale= 1.0d-4

i\_MaxSmAmp is also changed in GLA06, GLA12-15

- PR0000449 : Scale Factor For i\_maxSmAmp is wrong for GLA06, 12-15

Only minor repairs required to scale values for d\_maxSmAmp. Verification on glasdev under /glasdev1/flight\_data/elv\_20030315/sfm/zz\_maxsmamp.

- PR0000450 : The GSASV3.5 elevation manager can only be run with the intrp-POD option set

Elevations can now be run without the ANC08 file as input. The interpPOD flag is no longer required to be set to run.

- CR0000455 : GLA04-lrs possible duplicated data at granule seams

The main aim of this CR was to consistently use the individual shot time for granule boundary comparisons (as opposed to the less-precise input time). This means that granules boundaries now truly respect the start/stop times defined in the control file.

However, the reorganization of the L1AMgr necessitated by this change has generated a lot of impact. Here is a list of the (other) major changes:

L1AMgr reorganized from 1300+ lines of code to 600+ lines of code.

Used LPA d\_UTCTime as granule boundary master time for ALL GLA04 QA.

Code now structured such that the granule synchronization is done AFTER precise time is computed. QA code had to be restructured likewise.

The i\_time\_txWFPk code did not respect the possibility that not all AD Science packets are present. This was fixed.

Moved instrument state checks into own module.

Removed a significant amount of extraneous code. A lot of "IF" test could've been combined.

QA routines are run only if the appropriate QAP file is open.

Found possible podFlg problems. Initialized PODflg, bit 4, to 2.

Fixed problem where GLA03 AT QA interval was 16sec. Now is 3600 sec.

The selection of LPA as the master time to set granule boundaries leads to some of the GLA04s qap summary data such as IST and LRS which do time alignments to shots to be a few seconds short in the granules statistics. The actual granules contain the proper data. This is caused by the fact that there is only one QAP file per granule and the end of one file of the multi-files needs to force the granule stat wrapup.

- CR0000460 : QABrowse update for Release 11

In addition to updating the code, old .pro modules that were in /glas/vob/idl/qa\_browse and /glas/vob/idl/util were removed, and the /glas/vob/idl/util directory was removed. Util is now a subdirectory of qa\_browse.

- PR0000461 : Only one peak is removed in doAgainLoop in W\_Estimates

This corrects a typo that prevented W\_Estimates from removing more than one undesirable peak.

The line "doAgain = .TRUE." was inserted into the loop "doAgainLoop".

- PR0000464 : incorrect values for i\_txWfPk\_flag

The product database description and the flag PDF for i\_txWfPk\_Flag has been changed in GLA01\_main and GLA04\_LPA\_main.

- PR0000471 : The Fitting Process Always Keeps The Last Peak

Removed unneeded arguments in call to W\_Assess.

Removed code in W\_FunctionalFit that kept the last peak. Modified W\_Estimates to calculate sigma for the max-amp peak from the width of the WF at 80% of max-amp. Skipped new recalc of sigma for alternate parameters. Changed min sigma for fit of transmitted pulse from 2.5 to 0.8 so that narrow transmitted pulses will be fit. Corrected dimensions of variables associated with W\_Estimates so that all peaks on the transmitted pulse are detected instead of just the first one (mantis 554).

Put debug prints in W\_Assess. Removed arguments that were only used by W\_LsqFit when the transmitted pulse was being fitted in W\_Assess instead of W\_FunctionalFit.

Added code to W\_LsqFit that returns the reason that a peak should be removed (too small, too narrow, ...). Added debug prints to W\_LsqFit that can be activated by turning on a global-to-waveforms flag. Corrected a bug in W\_LsqFit that occasionally produced negative peak widths (mantis 265).

Changed I\_NSCAL2 from 1 to 0 so that the observed noise and standard deviation of the noise are used instead of being calculated (mantis 547).

- PR0000473 : Problem With ANC07 Global Variables

on branch /main/gsfc\_int/pr473:

/glas/vob/src/common\_libs/platform\_lib/const\_wf\_mod.f90

/glas/vob/src/common\_libs/anc\_lib/anc07\_wf\_mod.f90

/glas/vob/data/anc07\_001\_01\_0004.dat

Removed d\_dTHiRes.

/glas/vob/src/glas\_alt/WFMgr\_mod.f90

Changed d\_dTHiRes to gd\_dTHiRes.

on branch /main/WFF/wpr473:

/glas/vob/src/common\_libs/anc\_lib/anc07\_glob\_mod.f90

/glas/vob/src/common\_libs/platform\_lib/const\_glob\_mod.f90

/glas/vob/data/anc07\_001\_01\_0001.dat

Added gd\_dTHiRes. Changed gd\_ThrPcnt from 0.03d0 to 0.1d0

/glas/vob/src/common\_libs/anc\_lib/anc07\_l1a\_mod.f90

/glas/vob/src/common\_libs/platform\_lib/const\_l1a\_mod.f90



/glas/vob/data/anc07\_001\_01\_0005.dat

Removed d\_ThrPcnt & d\_dTHiRes.

/glas/vob/src/l1a\_lib/L\_Alt\_mod.f90

Changed d\_dTHiRes to gd\_dTHiRes. Changed d\_ThrPcnt to gd\_ThrPcnt.

Ran L1A, WF's, and Elevations for branch pr473 + wpr473, and for the integration branch using anc07's with the same values. The products did not change.

- CR0000477 : AtmMgr will not compile

Changes were made to AtmMgr\_mod.f90 under item cr477. The compile issue created by a previous change under Item 443 has been alleviated.

- PR0000478 : Inconsistent/incorrect determination of end of QAP averaging period

New module containing FUNCTION PastEndOfPeriod, to be called by all processes generating along-track QAP records to determine when the record ends.

- CR0000480 : The energy calculation needs to be laser/detector sensitive

Parameters d\_calibCoefTr and d\_calibCoefRec, used in calculation energy, are now laser/detector sensitive. We have reasonable values for detector 1, but no values for detector 2. The instrument team needs to provide values before any switch to detector 2.

Additionally, a problem was found where InstState flag had spares initialized to 1. The spares are now initialized to 0. Code was added to correctly set the Detector bits. These bits were previously documented, but code was not present to set them.

A minor error was corrected in the InstState PDF documentation. The InstState database entry was changed from invalid=i4b to invalid=no.

Correction made to i\_instState PDF, bit 19, changing Primary to Secondary. Change the product database for GLA01\_Main, i\_instState, invalid=i4b to invalid=no.

- PR0000481 : Likely incorrect invalid used for GLA01 i\_ADdetOutGn, and doc inconsistency

The GLA05 variables i\_gval\_tx and i\_gval\_rcv were changed to invalid value "NO"

- PR0000490 : QABrowse aborts when lat/lon points too close together

The code was changed to look for the point nearest to the test point rather than for a point within a specified distance of the test point.

- CR0000492 : GLA12-15 fit variances have incorrect units and descriptions

All four variables are derived directly from GLA05 parameters, and have equivalent units and scale factors. Thus:

GLA05%d\_wfFitSDev\_2 (standard) --> d\_IceSVar, d\_SeaIceVar, d\_OceanVar

GLA05%d\_wfFitSDev\_1 (alternative) --> d\_LandVar

The units for algorithm parameters are volts, and the units for product parameters are millivolts. The algorithm scale factor is 0.001, as previously communicated.

Definitions can be copied from GLA05, so that "The standard deviation of the difference between the functional fit and the received echo using standard (or alternative) parameters".

The variables GLA12:i\_IceSVar, GLA13: i\_SeaIceVar, GLA14: i\_LandVar, GLA15: i\_OceanVar have been updated with the Prod Units: millivolts, Alg Units: volts, Alg Scale: 1.00E-03 and new description.

- CR0000493 : GLA12-15 fit std dev fields don't have enough significant digits

The GLA12-15 fit stdev fields (d\_IceSVar, d\_SeaIceVar, d\_LandVar, d\_OceanVar) are now reported uniformly with product units of millivolts, and with improved precision.

- PR0000498 : QABrowse problems
  - 1) Was fixed by using all along-track records with good positions to define the x axis range for all plots.
  - 2) Was fixed by modifications to the routine that defines the map space. Complete testing is not possible, as it would require input files covering all possible situations, but the changes worked better with the available data.

Other problems noticed while working on this PR:

- 3) Some of the plot titles still read "Last peak" when they should read "Highest Peak". The version is now used to determine what the title should be.
  - 4) Some elevation plots had the line giving the time the plot was generated written twice, and some did not have it all. This was fixed by removing the duplicate call to the routine that was writing the time.
  - 5) For files generated for special requests, the data density can be high enough that data for low values are covered by data for higher values on the ground track maps (low value points are plotted first). As a partial fix, the symbol size will be reduced if the number of points is too high. For the test GLA14 file, which had nearly 14,000 along-track points, the reduced symbol size seemed sufficient. I am not sure how to deal with this if the data density is so high that the smaller symbol size doesn't solve the problem.
- PR0000499 : C\_CalcRNrg Not Calculating d\_RecNRGAll\_EU Correctly

Error codes were added to L\_Alt\_mod, anc07\_001\_01\_0000.dat, C\_CalctNrg & C\_CalcrNrg. The calculation of d\_RecNRGAll\_EU (GLA01 - Received Energy for All of Waveform) was corrected - in previous releases, d\_RecNRGAll\_EU had the same value as i\_RecNrgLast\_EU.

- PR0000500 : Problem With Received Energy Calculation In L1A

Error codes were added to L\_Alt\_mod, anc07\_001\_01\_0000.dat, C\_CalctNrg & C\_CalcrNrg. The calculation of d\_RecNRGAll\_EU (GLA01 - Received Energy for All

of Waveform) was corrected - in previous releases, d\_RecNRGAll\_EU had the same value as i\_RecNrgLast\_EU.

- CR0000505 : GLAS\_Atm fail on calibration file read

If calibration constant data is not available for the current time via anc36 files, processing continues and the 532 and 1064 calibration constants are set to the default values.

The 1064 calibration constant is always set to the default value regardless of the value of the flag gi\_use\_gcc\_f. This was done because experience with real 1064 data has shown that it is impossible to calculate the 1064 calibration constant from the atmosphere and we will always need to use the default value determined by other means.

In order to fix the problem of the program bombing when there are no anc36 data for the current granule, the error severity code associated with the -40026 error must be changed from 3 to 2. This is in the anc07. ... .0000.dat file.

The read problems that initiated this CR were the result of atm\_anc writing invalid values (largest number a double can hold) to the ANC36 file. When GLAS\_Atm tried to read this file, it would generate an I/O error. This forced changing the ANC36 file from a formatted ascii file to a binary unformatted file.

- CR0000506 : BALL Star tracker (BST) Sample time is incorrect

The sample\_time computation for GLA04\_05 (BST) data was changed. The appropriate bst\_dataLat value is now subtracted from the bst1/bst2 sample\_times.

Due to some data errors on GLA04\_05, more records are now being deleted due to overlapping (or exact) times.

- CR0000508 : the external GLA04 time latency values need to be updated

The GLA04\_06 (position/attitude) packet sample\_time external latency was changed from 0.0 to 0.0000015D0. This changes the GLA04\_06 sample\_time by +0.0000015D0 seconds.

- PR0000512 : Release 11 QAP05 along-track data not set

QAP05 along track data is now valid.

- PR0000521 : QAPG for GLA08 cannot handle large flies

Temporarily, the array size for GLA08 QAPG was changed to 30,000. A more permanent change should be made -- the GLA08 calculations should use onepass\_average\_mod, which will eliminate the need for keeping the individual values around.

- CR0000522 : clicking i\_reflctuncorr on GLA05 shows only on 05, but is also on 11b and 12

Changes made to the Product Database on 7/25/03, 08:00.

Changed `i_reflctuncorr` to be a common parameter of GLA05, GLA06, GLA12, GLA13, GLA14, GLA15. Insured that the above fields were documented per leeanne bug notes.

- CR0000534 : GLAS telemetry format change FSW CCR-016

Modified GLA01 product and L1A processing code to handle new GLAS Flight S/W CCR-006 Telemetry format.

The GLA01 format for the short and long record has been changed. The record length is the same but the spares at the end of the records now contain `gainStatus`, `NumCoinc`, `rawPkHt`. See GLA01 updated product description.

- CR0000545 : redefine current saturation bit in higher level products and add new ones

Release Notes:

Changed bit definitions in `wfqual` on GLA05 as follows:

bit 22 - saturation flag set - low gain situation

`Gain` <= 13cts, `WFAmplitude` > 220cts, `d_RecNrgAll_EU` > 15.0d-15j  
where `WFAmplitude` is the maximum amplitude.

bit 23 - saturation flag set - high gain situation

`Gain` >= 250cts, `d_RecNrgAll_EU` < 10.0d-15j, `pkWidth` > 20.0ns  
where `pkWidth` is the gaussian sigma in `i_parm2` for the last or closest-to-the-satellite peak.

bit 24 - saturation (high gain situation) and forward scattering

`Gain` >= 250cts, `d_RecNrgAll_EU` < 10.0d-15j, `pkWidth` > 20.0ns, `skew2` > 0.9

Removed the saturation bit from `elvflg` (bit 7).

Put saturation bit info into `i_rng_UQF` on GLA06 and GLA12-15.

bit 12 = 1, range measurement may be inaccurate due to saturation at low gain (same as `wfQual` bit 22)

bit 13 = 1, range measurement may be inaccurate due to saturation at high gain (same as `wfQual` bit 23)

bit 14 = 1, range measurement may be inaccurate due to saturation at high gain and significant forward scattering (same as `wfQual` bit 24)

- CR0000547 : `I_NSCAL2` in `anc07_0004` Should be Changed

Fixed on 471

- CR0000549 : The Documentation For GLA05%`i_parm1` & GLA05%`i_parm2` Needs Updating

Descriptions changed 07/24/03, Changes made per description in the Product Database of the variables `i_parm1` and `i_parm2` in GLA05.

The Description section of the documentation for `i_parm1` & `i_parm2` in `gla05` changed to:

(`i_parm1`)

"Parameters (in physical units) determined from the fit of the received echo using the alternative parameterization. In the order of: item1=noise (millivolts), then 6 sets of three Gaussian parameters (subitem1=amplitude (millivolts), subitem2=peak location (ns), and subitem3=sigma (ns)). Items 2-4 are the Gaussian parameters for the last (closest-to-the-ground or 1st) peak. Items 5-7 are the Gaussian parameters for the next-to-last (2nd) peak. ... Items 17-19 are the Gaussian parameters for the closest-to-the-satellite peak. If there are fewer than six peaks, the unused parameters are set invalid. Adding the location to i\_refRng gives the two-way range in time to the center of that peak."

(i\_parm2)

"Parameters (in physical units) determined from the fit of the received echo using the standard parameterization. In the order of: item1=noise (millivolts), then 6 sets of three Gaussian parameters (subitem1=amplitude (millivolts), subitem2=peak location (ns), and subitem3=sigma (ns)). Items 2-4 are the Gaussian parameters for the last (closest-to-the-ground or 1st) peak. Items 5-7 are the Gaussian parameters for the next-to-last (2nd) peak. ... Items 17-19 are the Gaussian parameters for the closest-to-the-satellite peak. If there are fewer than six peaks, the unused parameters are set invalid. Adding the location to i\_refRng gives the two-way range in time to the center of that peak."

- PR0000554 : transmit pulse fitting problem

Fixed on branch pr471 - see mantis 0000471.

- PR0000563 : tidal values have been applied with wrong sign to elevations on GLA06, 12-13

For Release 12, the spot location is calculated using a range corrected for tropospheric delay, internal range bias, and external range bias. The tides are then applied to the resultant elevation.

Release 11 had the tides applied with the wrong sign to the range before the spot location and elevation were calculated.

- PR0000590 : C\_CalcNrg uses GLAS\_Error but does not return error severity

Error codes were added to L\_Alt\_mod, anc07\_001\_01\_0000.dat.

- CR0000597 : Metadata QA parameter name changes

Changes to the anc45 12-15 files are listed below.

/glas/vob/data/anc45\_001\_01\_0012.dat

Previous ----->Current

Elevation Data----->Surface Elevation

Laser Reflectance---->Surface Reflectance

Roughness----->Surface Roughness

Slope----->Surface Slope

/glas/vob/data/anc45\_001\_01\_0013.dat

Previous----->Current

Laser Roughness----->Surface Roughness

Elevation Data ----->Surface Elevation

Roughness----->REMOVED

/glas/vob/data/anc45\_001\_01\_0014.dat

Previous----->Current

Digital Terrain Elevation Data->Surface Elevation

Roughness----->Surface Roughness

Slope----->Surface Slope

Laser Reflectance----->Surface Reflectance

/glas/vob/data/anc45\_001\_01\_0015.dat

Previous----->Current

Elevation Distribution--->Surface Elevation

Roughness----->Surface Roughness

Reflectance----->Surface Reflectance

Sea Surface Height----->REMOVED

- CR0000623 : remove mention of pole tide from PAD description

Updated the Product Database description for the variable i\_PADPoint in GLA05, GLA06, GLA12, GLA13, GLA14, & GLA15. Removed the sentence "This also includes the effect of the pole tide." from the description.

- CR0000632 : Set metadata QA

Changes to the anc45 files and testing were done on Branch 597 along with changes from that mantis item.

Note: In the Mantis description for this item, AutomaticQualityFlag has to be set to Suspect, there is no Inferred Passed allowed for this item. The only choices for AutomaticQualityFlag are Passed, Failed and Suspect. The Automatic, Operational, and Science Quality Flag Explanation can be anything of our choosing within the 255 character limit.

Changes to anc45 files were as such

AutomaticQualityFlag = Suspect (changed from Passed to Suspect)

OperationaQualityFlag = Inferred Passed (no change here)

ScienceQualityFlag =Failed (changed from Inferred Passed to Failed)

-added explanation of suspect to automaticqualityexplanation.

AutomaticQualityFlagExplanation = Passed indicates parameter passed for specific automatic test; Suspect, QA not run; Failed, parameter failed specific automatic test.

- PR0000649 : makefile for atm\_anc needs -lmath

Added -lmath as requested. (immediate integration-branch check-in)

- PR0000662 : WF Fit is Worse on Some Wide Noisy Peaks

Added d\_maxGoodsDev to anc07\_001\_01\_0004.dat, const\_wf\_mod.f90, anc07\_wf\_mod.f90, and l\_FunctionalFt\_mod.f90. For standard parameters, passing second estimate for the maximum-amplitude peak location and width to W\_PerformFit. W\_PerformFit tries the fit again using the second set of estimates if the first fit standard deviation was greater than d\_maxGoodsDev. If the second fit standard deviation is larger, then the first fit parameters are kept.

- PR0000664: relectance calculation should use transmit energy calculated from each shot

The transmitted energy is now calculated for each shot (instead of once per second) when calculating reflectance in W\_Assess. d\_gainTr is passed from WFMgr to W\_Assess. C\_CalcTNrg is called by W\_Assess.

- AI0000671 : optical transmission change from .555 to .67

Changed optical transmission calibration value from 0.555 to 0.67.

- PR0000674 : i\_gainSet1064 is not treated correctly as an unsigned

Fixed a problem where i\_gainSet1064 was not being correctly handled as an unsigned value.

- CR0000676 : ECS reported that some changes to .MET not acceptable

Several typos in the .met files were detected by ECS. These were subsequently corrected.

- PR0000680 : Inadvertent filtering of negative values in GLA05 words

Computational problem corrected in GLA05 which prevented negative values from appearing in the deltagpstmcor, beam\_azimuth, and beam\_coelev values. As these values are pass-throughs to GLA06 and 12-15, the problem also appears there.

- PR0000688 : no leading edge and no trailing edge and no signal defined incorrectly

The code that sets the flags gwi\_noLeadEdg1, gwi\_noLeadEdg2, gwi\_noTrlEdg1, gwi\_noTrlEdg2, gwi\_noSig1, & gwi\_noSig2 in GLA05%l\_WFqual has been corrected. W\_FunctionalFt checks these flags before trying to fit the WF.

- CR0000709 : Spare2 listed twice in GLA09

Renamed spare3, offset 3988 to spare4 & renamed spare2, offset 242 to spare3 in GLA09 documentation.

- CR0000720 : change d\_nsig2 on anc07 waveform file to not process just noise

For standard fit d\_nsig2 was increased from 8.0 to 15.0. This is used to determine signal threshold as a multiplier of the standard deviation of the noise. In release 12 for the standard parameterization we changed to use the observed values of the mean and standard deviation of the noise instead of calculating the values. The observed

values are from the background and will always be less than or equal to the noise region of the telemetered return. Therefore the constants used to calculate the signal thresholds had to be raised also.

### **5.4.13 Release Notes for GSAS v3.6.1**

GSAS 3.6.1 is a minor bugfix which closely followed GSAS 3.6.

The GD\_IST\_COI\_LIM parameter was changed from 120 to 135 in ANC07\_05. This is due to higher than previously seen values in the IST COI data. This should fix some data gaps caused when COI values higher than the limit were intentionally not used in processing.

GLA04 QAP is not supported in GSAS 3.6 or GSAS 3.6.1.

An L1A problem was fixed in GLA04 processing.

An error in waveform processing when no signal was detected was fixed.

### **Product Format/Definition Change Summary**

None

### **Known Problems**

GSAS v3.6.1 introduced no new known problems.

### **Release Information**

The ClearCase label for this release is RELEASE\_3.6.1. The release date is September 02, 2003. Version numbers have been updated to "V3.6.1 September 2003" for the following:

- wf\_lib
- GLAS\_L1A
- anc07\_05

### **Detailed Change Notes**

- PR0000728: REL 12 L1A jobs failed due to time > POD time

The L1A bundle has been changed to exclude QAP04 as a required output. An additional, related problem has been found and addressed in PR0000737.

- PR0000733: coding error in W\_estimates

W\_FunctionalFt\_mod.f90 has an added IF loop after the original loop in question that tests for a case with no signal in the transmit pulse. It keys off the possibility that the begin/end bin indices might be zero (which is what caused the original execution termination).

- PR0000737: GLA04 output granules do not close correctly when the respective instrument is off



Added a check to GLA04 granule output tests to catch a condition where processing may not end at the specified time if no data is available for a GLA04 granule.

- CR0000762: Need to change GD\_IST\_COI\_LIM in ANC07\_05

The GD\_IST\_COI\_LIM parameter was changed from 120 to 135 in ANC07\_05. This is due to higher than previously seen values in the IST COI data. This should fix some data gaps caused when COI values higher than the limit were intentionally not used in processing.

#### **5.4.14 GSAS v3.7 Release Notes**

GSAS 3.7 contains fixes and minor modifications for L1A, Atmosphere, Waveform, and Elevation processes and products.

For L1A, the following changes were made:

- Added alarm limit checking for GLA03. Improved GLA03 Quality Assurance (QAP).
- Fixed duplicate times in GLA04 BST and fixed condition where GLA04 IST and LRS granule end times were 0. Fixed an error in GLA04 IST when the timetag=0. Software now generates QAP04 files.
- Improved GLA01 and GLA02 parameter data base documentation.
- Made laser energy calculations component-sensitive and updated related coefficients.
- Fixed errors and made general improvements in the GLA02 processing code.

For Waveforms, the following changes were made:

- Made laser energy calculations component-sensitive and updated related coefficients.
- Improved GLA05 parameter data base documentation.
- Fixed a problem where some elevations were shown as invalid on GLA05 but valid on elevation products – these invalid elevations will now be valid on GLA05
- Modified weighting of measurements in waveform fitting procedure to use more realistic numbers. This allowed more iterations for irregular returns.
- Fixed option that allows GLA05 to be created with predicted orbits – not used for normal processing, just testing of algorithms by the science team.
- Improved QAP05.
- Fixed transmit pulse major axis – I\_tpmajoraxis; now stored in cm so will not overflow 2 byte field – negative numbers in previous releases were caused by this overflow
- Fixed a problem where the max-amp peak had an invalid estimate and was being discarded.

For Elevation processes, the following changes were made:

- Added calculation of the ground track azimuth from footprint locations; d\_azimuth.
- Fixed i\_sigmaatt (Attitude Quality Indicator)
- Fixed a problem that did not output negative Sun Angles
- Fixed transmit pulse major axis – I\_tpmajoraxis; now stored in cm so will not overflow 2 byte field – negative numbers in previous releases were caused by this overflow
- Improved elevation QAP (QAP05,12-15).
- Fixed a problem with isolated and sporadic spikes in the GLA06 azimuth value.

For Atmosphere, the following changes were made:

- The atmosphere calibration file was modified to handle larger values / more precision.
- GLA10 and GLA11 will now have non-0 values.
- Fixed 532 afterpulse correction (SPCM run on after hitting thick clouds)
- 532 calibration constant is being computed from anc36 (prior releases used a default constant)
- Fixed 1064 background correction
- Implemented 532 Channel Afterpulse Correction

Other, more general fixes include:

- Several flag definitions were changed / updated.
- Production documentation was updated / fixed.
- Significant changes were made to the QA and browse products.
- Metadata files were updated to work with ESDT changes.

### **Product Format/Definition Change Summary**

GLA01:

“i\_ObScHt” changed product units=millimeters, algorithm units=meters, minimum value= -1.0D9, maximum value= 1.0D9

“i\_txwfPk\_Flag” changed maximum value=8

“i\_instState” changed maximum maximum value=524288

“i\_Hoff” changed product units=millimeters, algorithm units=meters, minimum value= -1.0D9, maximum value= 1.0D9

“i\_4nsBgMean” changed product units from counts to .01 counts

"i\_4nsBgSDEV" changed product units from counts to .01 counts

#### GLA05

"d\_maxTrAmp" changed scale 1.0d-3 to 1.0d-4

"d\_maxTrAmp" changed product units millivolts to 0.1 millivolts

"i\_gval\_rcv" & "i\_gval\_tx" changed Invalid value NO to i2b

"i\_maxRecAmp" changed min value= -300, max value= 30000

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_maxTrAmp" changed min value= -300, max value= 30000

"i\_npeaks1" changed min value= 0, max value= 50

"i\_tpmajoraxis" changed product units to centimeters

"i\_centroidInstr" changed description to "surrounding the maximum amplitude peak"

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

"i\_solnSigmas1" changed description

"i\_solnSigmas2" changed description

"i\_pcnts1", "i\_pcnts2" changed To spares

#### GLA06

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_reflcor\_atm" changed min value= 0, max value= 1000000

"i\_npeaks1" changed min value= 0, max value= 50

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

#### GLA12

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_reflcor\_atm" changed min value= 0, max value= 1000000

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

#### GLA13

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_reflcor\_atm" changed min value= 0, max value= 1000000

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

#### GLA14

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_reflcor\_atm" changed min value= 0, max value= 1000000

"i\_npeaks1" changed min value= 0, max value= 50

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

GLA15

"i\_maxSmAmp" changed min value= -300, max value= 30000

"i\_reflcor\_atm" changed min value= 0, max value= 1000000

"i\_sigmaatt" changed possible values to 0 (good), 50 (warning), and 100 (bad)

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v37\\_products/](http://glas.wff.nasa.gov/v37_products/).

### **Known Problems**

GLA16 is still not ready for production.

### **Release Information**

The ClearCase label for this release is RELEASE\_3.7.

The release date is December 05, 2003.

Version numbers have been updated to "V3.7 November 2003" for the following:  
all libraries

- GLAS\_L1A
- GLAS\_Alt
- GLAS\_Atm
- GLAS\_Meta
- anc07\_00
- anc07\_01
- anc07\_02
- anc07\_03
- anc07\_04
- anc07\_05
- anc45\_01-15

This should be verified during operation by checking the version information in the appropriate ANC06 files.

### **Detailed Change Notes**

- 0000334 : d\_Azimuth is always invalid

The footprint track azimuth is now computed and included in GLA06 and GLA12 through GLA15. This quantity was not previously computed, with only an R\*8 invalid value filled in as a default.

- 0000338 : GLA02 Release 12 problems found from QA

No action was required.

- 0000367 : Add alarm limits for use with QAP03

Added limit checking functionality to QAP03. The nominal on orbit yellow limits are checked for each temperature, voltage, and current on the GLA03 product. When a temperature, voltage or current goes above or below the yellow limits, an error code is created, and is shown in the anc06 file for every 500 occurrences. A counter for the "OUT BNDS" with the corresponding variable name is in the QAP03 summary output structure.

- 0000476 : Completion of testing for sigmaatt data change

The Attitude Quality Indicator, *i\_sigmaatt*, has been revised. This parameter appears in GLAS data products 05, 06, and 12-15. Values now available are 0 (good), 50 (warning), and 100 (bad). Previous data products only carried values of 0 (good) and 1 (bad).

- 0000504 : QAP03 along-track and summary start and end times incorrect

Changes the along track time frame from an incorrect 16 seconds, to the correct time of 3600 seconds so the along track statistics are collected over one hour. A change was made to allow for the along track and summary start and stop times in the QAP file to reflect the actual time of the data, rather than the requested start and stop time from the control file. The GLA03 data is every 16 seconds, and because the start and stop of the data may not reside on a perfect 3600 second boundary there may not always be exactly 3600 seconds in an along track record. There could be up to a 15 second deficit due to the start and stop times of the data. If you have 1.5 hours worth of data, the second along track would also not be a full 3600 seconds, but will measure statistics on the entire 1800 seconds that are available.

- 0000516 : Coordinate anc08 and anc09 File Opens with Manager Access

Software has been amended to guarantee that orbit and attitude degradations contained within the headers for anc08 and anc09 files is set appropriately for WF, ELEV, and ATM software subsystems. It is also possible to substitute alternate files between WF and ELEV processing and to have the flags be reset rather than just passed up through the GLAS product data chain.

- 0000531 : Histogram of freeboard for GLA15 computed incorrectly

The computation of the oceans elevation histogram in the QAP file for the GLA15 data product has been corrected. It was previously computed incorrectly using the sea ice values. The parameter being tallied for a histogram is not really freeboard (height of ice above sea level). It is the elevation of the ocean level w.r.t. earth's geoid. The new parameter name is *i\_HistElevWRTGeoidOC*.

- 0000558 : Lat/lons not changing within 40 Hz for some GLA05

Whenever processing conditions result in an invalid set of lat/lon coordinates because there is no signal, the 1 Hz coordinates are retrieved from GLA01 and propagated into higher level product files. Though understandably less accurate, an approximate coordinate is better than no coordinate. This substitution can happen for an entire record, or for just a portion of the shots within a record, or for several non-connected portions of the shots within a record. Thus the coordinates appear "choppy" and discontinuous; however, this is so only when the signal is not usable. The User's Guide will be amended to show this condition so that it is understood to NOT be an error condition. Also, the NSIDC User's Guide has had the comment added indicating if wfqual indicates no signal then the geolocation is predicted at a 1Hz rate.

- 0000594 : ElevMgr : Incorrect use of LOGICAL function

This software change causes no known differences in GLA products--it merely averts a potential execution change.

- 0000596 : Remove array from subroutine A\_qa\_G8\_11

An array size limitation for processing of GLA08 QA data related to PBL (planetary boundary layer) height has been eliminated.

- 0000656 : No QAP04 from integration branch

GLA04 QAP files are now filled appropriately. Also see CR0000750.

- 0000686 : Array size error in funpk\_AttFlg2

This corrects a potential trouble spot in the software which manipulates the attitude flags; however, it was an error that did not manifest any known data errors in the GLAS products.

- 0000687 : gla01 units on product and algorithm are both counts, but there is a scale factor other than 1

Prod Units have been changed from 'counts' to '.01 counts' in the variables i\_4nsBgMean & i\_4nsBgSDEV

- 0000702 : The Elevation manager will incorrectly calculate the Sun angle if ANC09 is not being used as an input

See Items PR0000829, PR0000816, PR0000706.

- 0000706 : fake PAD used in calculation of beam coelevation and azimuth in elev mgr

See Items PR0000829, PR0000816, PR0000706.

- 0000721 : The BST has near duplicate times

Added code (under PR0000750) to throw out data if time2-time1 < .001 seconds.

- 0000724 : Documentation for GLA05%i\_centroidInstr Needs to be Updated

Changed the long description "surrounding the last peak" to read "surrounding the maximum amplitude peak".

- 0000725 : Spurious records from logic error in ElevMgr

A logic error was resolved in ElevMgr which eliminated the introduction of spurious scattered data records into products GLA12-GLA15.

- 0000729 : V3.6 Product Database Errors

The following are the changes that were made:

alg var "i\_AttFlg" changed i4b(5) to i4b(8) in GLA05,06,07,12-15

changed i4b(4,4) to i4b(8,4) in GLA08-11

alg var "i\_podFlg" changed i4b(3) to i4b(6) in GLA01,02,05-07,12-15

changed i4b(3,4) to i4b(6,4) in GLA08-11

alg var "rngCorrFlg" changed i4b(5) to i4b(7) in GLA05,06,12-15

alg var "i\_elvFlg" changed i4b(40) to i4b(8,40) in GLA05,06,12-15

alg var "i\_RngOffQF" changed i4b(8,40) to i4b(16,40) in GLA06,12-15

alg var "i\_SurfRuf\_slpQF" changed i4b(2,40) to i4b(7,40) in GLA06,12,14

alg var "i\_SiRufQF" changed i4b(2,40) to i4b(7,40) in GLA13

alg var "i\_OcRMSqf" changed i4b(2,40) to i4b(7,40) in GLA15

alg var "i\_DEMmin" & "i\_DEMmax" changed name to "d\_DEMmin" & "d\_DEMmax" in GLA02

changed i4b to r8b in GLA02

alg var "d\_maxTrAmp" changed scale 1.0d-3 to 1.0d-4 in GLA05

changed product units millivolts to 0.1 millivolts in GLA05

prod var "i\_gval\_rcv" & "i\_gval\_tx" changed Invalid value NO to i2b in GLA05

- 0000740 : Laser energy Calibration Coefficients need to be Component Sensitive

Updated formulae for calculating energy. Some variables used in energy calculation are different depending on which laser, detector and digitizer are being used. The code now checks the instrument state and selects the correct values.

- 0000750 : The IST "bad" COI Algorithm Needs Change

In the IST data, a bad time computation is occurring which causes x seconds of data to be out-of-order and deleted.

This seems to be a problem which occurs when the IST timetag goes to 0. The code was supposed to delete a whole PRAP record when the timetag=0, but subsequent investigation determined that this was not happening correctly. I put in code which

does a better job of deleting the record when timetag=0, and this seems to have fixed the problem.

- 0000751 : Nose Data for the 91 Day Orbit to ECS

Fortran program has been written that converts the ANC28 data file to same format, but with track numbers all incremented by desired value. Program accepts input & output file names as user-inputs, as well as the track-increment factor.

- 0000774 : anc08 and anc09 Description Changes

Database descriptions for ANC08 and ANC09 were modified.

- 0000789 : QAPG will not compile with new QAP03 Changes

A temporary fix was put in to disable GLA03 calculations. The code now compiles, builds and runs as before except for its treatment of GLA03.

- 0000791 : GLA04 LRS/IST may Report Endtime of Granule=0 when no Alignment occurs at Dnd of Processing

com\_hdr\_update updates the stop time of the granule with the actual granule stop time when the granule is closed. If the data happens not to align when the granule is closed, a time=0 is used instead of the last good time. Code was changed to use the last good time.

- 0000792 : Correct Weighting in Least Squares Fits

Changed weights for fit to depend on an anc07 value. Fixed calculation of standard deviation of fit in LsqFit\_mod. Fixed pr872, a typo that caused the number of iterations in the QA to be incorrect.

- 0000793 : L1A passthru to L1B

Added comments to GLA02 and GLA07 variable descriptions which indicate conditions in which values are not valid.

- 0000795 : Update QAPCompare for new V&V Requirements

QAPCompare was updated to meet newly defined V&V requirements and control changes were made to allow easier use in the SDMS environment.

- 0000806 : Some Elevations Invalid on GLA05 are Valid on GLA06

A software flaw in W\_Assess module has been repaired which caused elevation values in GLA05 to be invalid, where in fact legitimate data exists. This processing deficiency was proven to have affected 7.5% of data records in the sample of data used for problem diagnosis.

- 0000816 : WFMgr Crashes if no ANC04

See items 0000829, 0000706, 0000702.

- 0000824 : i\_pcmtSat1, i\_pcmtSat2 on GLA05 need to be set to Spares



On GLA05, i\_pcntSat1 changed to i\_spare1.1 and i\_pcntSat2 changed to i\_spare1.2. The prod variable type was left as i2b(40) for spares.

- 0000829 : Default Value For d\_OffNadirAngTrop is Incorrect

The default value for d\_OffNadirAngTrop in ElevMgr was changed from gd\_PI to gd\_PI\*0.5d0. Also see items 0000816, 0000706, 0000702.

- 0000838 : Run Atmospheres w/o ANC09 causes CRASH

An potential error was removed that affected the execution of the atmospheres GLAS\_Atm code. Whenever it was run without the ANC09 attitudes file the program crashed because it was attempting to search the non-existent data to set flags.

- 0000842 : Release 12 Waveform-QAPG Discrepancy

Changed calculation of along-track average start and end, and the times of first and last shots in average written to the along-track records to agree with the times specified by Mantis 647. NOTE: One change implicit in this mod -- if the frame time (d\_UTCTime) is invalid, the data will not be included in the averages.

- 0000872 : QA For GLA05 NumIters Incorrect

See item 0000792.

- 0000876 : Integrate SCF Reader Code into VOB

Stored sample GLAS product reader code created by the SCF into the VOB. The code does not require the large shared libraries used by other GLAS software. Sample code is delivered in src/prod\_util/scf\_product\_readers.

- 0000877 : QABrowse Updates

QABrowse was updated to correct a number of problems and to meet new requirements.

- 1) QABrowse now returns exit codes as does the other GSAS software.
- 2) QABrowse now exits gracefully if it is given a file with no data
- 3) A number of minor problems were corrected and additional desired enhancements and changes were implemented.

- 0000881 : GLA10, 11 Full of Zeros

Uncommented the call to A\_aer\_opt\_prop which sets values for GLA10 and GLA11. Products now have values.

- 0000892 : Tolerance in CreateGran\_util was set too loose for the 91 day Reference Orbit

Tightened the tolerance when matching the Predicted orbit equator crossings (ascending) with the Reference orbit equator crossings to 0.1 degrees longitude.

- 0000894 : Investigate NOSE Anomalies

Added more error checking to NOSE routines. New sanity checks were limited to lat/lon boundary checks, invalid checks, and count exceeding maximum number of entries checks. Upped the limit of revs/granule to 15 (from 14) and put custom read/conversion routines into GLAS\_Meta in order to greatly increase performance.

- 0000921 : Data Glitch Occurring in Track 1099 Segment 4

Determined this is caused by bad PAD values.

- 0000944 : ANC07 Energy Conversion coef Need to be Updated

See items 0000740 & 0000951.

- 0000945 : Errors in GLA01 Documentation

Changes were made for the following variables in GLA01\_main.

i\_ObScHt:

product units=millimeters, algorithm units=meters, minimum value= -1.0D9, maximum value= 1.0D9

i\_txwfPk\_Flag:

maximum value=8

i\_instState:

maximum value=524288

i\_Hoff:

product units=millimeters, algorithm units=meters, minimum value= -1.0D9, maximum value= 1.0D9

- 0000947 : Changes to Product Min & Max In Database

Made the following changes:

i\_maxRecAmp; min value= -300, max value= 30000 in GLA05

i\_maxSmAmp; min value= -300, max value= 30000 in GLA05,06,12-15

i\_maxTrAmp; min value= -300, max value= 30000 in GLA05

i\_reflcor\_atm; min value= 0, max value= 1000000 in GLA06,12-15

i\_npeaks1; min value= 0, max value= 50 in GLA05,06,14

- 0000948 : Negative i\_tpmajoraxis in GLA05 & GLA06

An integer overflow problem in the parameter tpmajoraxis in products GLA06, and 12-15 has been corrected. This problem was the result of an inappropriately selected measure of millimeters for product units, and a product-to-algorithm scale conversion factor that consistently produced an overflow. The product unit of measure has been changed to centimeters.

- 0000949 : Negative d\_SolAng

A minor clarification was made to the online product database description for the range of the d\_SolAng parameter.

- 0000961 : Spikes in 1-second Footprint Azimuth Values

Two parameters have been added to the anc07 file for elevations and its access software which allow the computed footprint azimuth to be filtered in two ways. If the number of computations involved in a 1-second interval is less than gi\_GT\_Azimuth\_Num\_Vals or if the computed standard deviation within the interval is greater than gd\_GT\_Azimuth\_StDev, then the computed azimuth is set to invalid. Implementation of these filtering parameters involved incorporating the OnePass module for computing averages and standard deviations.

- 0000951 : Reflectance Is Too Large

See 0000740 & 0000944.

- 0000985 : Atmosphere Constants Changes

Changed several constants which should improve the quality of atmosphere processing.

- 0000994 : GLA02 Code Error in 1064 Channel Data Usage of Background

Corrected a background subtraction problem in the GLA02 code. Not enough background was subtracted off for the 1064 channel. This ultimately created problems in GLA07 for the computation of 1064 attenuated backscatter.

- 0001024 : 532 Channel Afterpulse Correction

The GLAS 532 nm atmospheric channel has a problem known as 'afterpulsing'. This occurs when a thick cloud or sloping terrain is encountered and the return signal is very large. The strong return causes the 532 detectors to remain stuck on, with a high output count rate, when in fact they should be putting out zero. This problem was corrected.

- 0001028 : QABrowse should be able to produce HDF File

QABrowse can now generate hdf output. All previous capabilities are still present. The hdf file contains 8-bit raster images.

- 0001031 : anc07-0005 change ATM constant GI\_G\_USEDDBG

Changed the selector for how to compute the background for the 532 channel.

- 0001045 : ANC45/46 Changes for GSAS 3.7

VersionIDs changed in to 13 in ANC45 and ANC46. Requested NSIDC made appropriate changes to the ESDTs.

- 0001051 : Occasional No Fit (alt) For Good WF

Corrected bug where alternate fits were trying to use the 2nd estimate when the standard deviation of fit wasn't good enough, only it was not being set and was still invalid. That meant that the max-amp peak had an invalid estimate & so was thrown

out. Changed code so that the estimate for the max-amp peak is calculated in a similar way for both standard and alternate fits.

- 0001070 : Change Description of GLA05 d\_solnSigmas 1 and 2

Description changed for solnSigmas1 & solnSigmas2. Added the following description to both:

In the order of: item1=noise (millivolts), then 6 sets of three parameters (subitem1=amplitude (millivolts), subitem2=peak location (ns), and subitem3=sigma (ns)). Items 2-4 are the parameters for the last (closest-to-the-ground or 1st) peak. Items 5-7 are the parameters for the next-to-last (2nd) peak. ..Items 17-19 are the parameters for the closest-to-the-satellite peak. If there are fewer than six peaks, the unused parameters are set invalid.

- 0001093 : Change Frequency of errors -40031 and -40032

Changed the frequency of -40031 and -40032 errors reported during atmosphere processing.

#### **5.4.15 GSAS v3.8 Release Notes**

GSAS 3.8 contains fixes and minor modifications for L1A, Atmosphere, Waveform, and Elevation processes and products.

For L1A, the following changes were made:

- Improved GLA03 Quality Assurance Product (QAP).
- Added check to skip ancillary science packets if specific shot times = 0.
- Updated APID data structures to correspond with GLAS-582-SPEC-005-IPS45.xls
- Fixed errors and made general improvements in the GLA02 processing code, including using Pin E data for normalization of 532 laser energy data.
- Changed GLA02 transmit energy to 40/second.
- Fixed problem causing error when QAP04 was created.

For Waveforms, the following changes were made:

- Improved QAP05.
- Two parameters previously set invalid were redefined as spares

For Elevation processes, the following changes were made:

- Iceberg elevation parameter in GLA13 is now computed – it was previously set to invalid. This is computed blindly everywhere there are multiple peaks to the return, no sanity check is made to make sure it is not over land.

For Atmosphere, the following changes were made:

- Fixed beam\_coelev and beam\_azimuth on GLA08-11.

- Placed pad\_angle on GLA08-11.
- Made major changes to the background computation.
- Improved layer threshold computations.

Other, more general fixes include:

- GLAS\_Tick, a new PGE, was delivered to create oscillator rate trend files.
- Production documentation was updated/fixed.
- Significant changes were made to the QA and browse products.
- Metadata files were updated to work with ESDT changes.

### **Product Format/Definition Change Summary**

GLA01:

minor modifications on engineering data descriptions  
update documentation for RecNRGLast\_EU

GLA03:

Replaced existing spare55)i1b(8,4) with:

CD\_PWaccum i4b(4)

CD\_PWlong i1b(4)

CD\_PWshort i1b(4)

CD\_PWmsb i1b(4)

changed spare55\_4 i1b(8,4) to i1b(1,4)

GLA05:

spare1.1 (previous pcnts1) chg to spare7

spare1.2 (previous pctns2) chg to spare8

GLA08-11:

Replaced existing spare, spare0 i1b(56) with:

PAD Angle pad\_angle i4b(4)

changed spare spare0 i1b(56) to i1b(40)

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v38\\_products/](http://glas.wff.nasa.gov/v38_products/).

### **Known Problems**

GLA16 still not supported.

Additional parameters need to be added to QAP03.

LRS subject change algorithm needs to be implemented.

SIRU sample time correction algorithm needs to be implemented.

More atmosphere changes are pending.

QAP05 lists all waveforms as always valid – this is a mistake- probably in the total number of waveforms

Lots of other QA tweaks needed.

### **Release Information**

The ClearCase label for this release is RELEASE\_3.8.

The release date is February 10, 2004.

Version numbers have been updated to “V3.8 February 2004” for the following:

- all libraries
- GLAS\_L1A
- GLAS\_Alt
- GLAS\_Atm
- GLAS\_Meta
- anc07\_02
- anc07\_05
- anc45\_01-15
- anc46\_xx (see item 0001024)

This should be verified during operation by checking the version information in the appropriate ANC06 files.

### **ANC Files**

New versions of all the ANC07\_02, ANC07\_05, ANC45 and ANC46 data files are required.

### **New PGE**

GLAS\_Tick, a new PGE, is now provided. It should be run after the L1A process is completed and an ANC09 file is received. A new section has been added to the GSAS User Guide detailing the PGE.

### **Detailed Change Notes**

- 0001264: Maximum Value of Received Energy needs to be Higher Change 20000 to 200000

GLA01\_Main parameters i\_RecNrgAll\_EU and i\_RecNrgLast\_EU, max values have been changed from 2000 attojoules to 200000 attojoules in the product database documentation.

- 0001261: QABrowse Problems

Fixed problem with case of the file extension on HDF output files. Fixed various problems seen in GSAS 3.8b2 ACCTEST products.

- 0001246: Bad APID19 record after MEU Reset causes Time Problems

A new sanity check was introduced into GLAS\_L0p which checks that the following shot counters are  $> 0$  and  $< 200$ . The record is skipped if the test fails.

i\_SCPosPktShot (Shot count for SC pos Pkt)

shot(j)%i\_ctr (Shot count)

- 0001243: Update Product Release Numbers in ANC45

The product release numbers were updated in ANC45 to Release 15.

- 00001218: Invalid Co-elevation Angle on GLA10-11 and Addition of pad\_angle to GLA10-11

A software oversight was corrected which now allows the parameters beam\_coelev and beam\_azimuth to be propagated from GLA07 to products GLA08 through GLA11. In addition, software additions were made which place the pad\_angle into products GLA08-GLA11. Online documentation has been modified to reflect this addition.

- 0001205: QAP04 caused EOF Condition in some Cases with ANC09

A single line of code got deleted out of L1A\_QAP\_mod.f90. This line initialized a variable which checked for the end of granule condition on QAP04. I have put this line back in.

- 0001204: ANC file ESDTs

Updated version numbers for the following ANC files:

GLAANC04 rel 5

GLAANC08 rel 5

GLAANC09 rel 9

GLAANC20 rel 4

GLAANC25 rel 5

GLAANC26 rel 1

GLAANC33 rel 7

GLAANC37 rel 3

GLAANC39 rel 4

- 001193: Update GLA01 Documentation for i\_RecNRGLast\_EU

GLA01\_Main variable `i_recNRGLast_EU` has been changed. Name Field and Description has been corrected to read per above instructions.

- 0001177: Normalization of 532 by Pin A in GLA02 Problem

The change to the use of Pin E instead of Pin A for laser energy normalization in GLA02 will result in the removal of spurious signal intensity fluctuations introduced by the incorrect Pin A values. This will increase the quality of GLA07 and subsequent atm data products.

The background computation change should produce a more stable and reliable background subtraction that will increase the signal to noise of the daytime data.

The offsets applied to the range to the top of the profile (`d_Rng2PCProf` and `d_Rng2CDProf`) will increase the vertical alignment accuracy in GLA07. Prior versions of GLA07 had about a 2 bin (150 m) error in the vertical alignment of the data within the GLA07 height reference frame. This fix will also result in more accurate cloud and aerosol top and bottom (GLA08 and GLA09).

Additional changes made on cr1177:

`L_Atm_mod.f90`:

- major change made to background computation. A one second average background is computed from the average of the first 100 bins of the 20-40 km profile minus an assumed molecular backscatter contribution (a constant).
- Dead time correction change to 532 channel. New version first subtracts the background from received signal and dead time corrects the result.
- Valid raw data limits changed for 1064 channel. Prior versions required raw 1064 data to be  $\geq 0$  and  $\leq 255$ . This was changed to  $\geq -255$  and  $\leq 500$  to accommodate the fact that the droop correction will alter raw data values to this extent.

`AtmMgr_mod.f90`:

- The biases applied to `GLA02%d_Rng2PCProf` and `GLA02%d_Rng2CDProf` had incorrect sign. Changed them to +206.8 and + 130.0, respectively.

`A_20s_aer_det_mod.f90`: (Actually done and merged from branch cr717 by mistake)

- Layer threshold computation changed to reduce occurrence of false positives.

`A_4s_1064_det_mod`:

- Layer threshold computation changed to increase effectiveness of finding layers.

`A_pbl_det_mod`: (Actually done and merged from branch cr717 by mistake)

- Added invalid data check.

`A_20s_1064_det_mod.f90`:



- Layer threshold computation changed to reduce occurrence of false positives. Layer threshold computation changed to increase effectiveness of finding layers. Added invalid data check to fix IEEE overflow problem.

A\_cld\_lays\_mod.f90, A\_cld\_det\_mod.f90 and A\_cld\_grd\_det\_mod.f90:

- Changes to threshold computations to reduce false positives.

Anc07\_0002.dat:

- Changed GI\_AER\_TOP\_HT from 36000 to 30000. This is start height for aerosol layer searches.
- Changed GI\_CC\_ELIM\_F from 1 to 0. This is the flag to eliminate calibration points taken during daylight. 1 eliminates them, 0 will include them.
- Changed GI\_CALC\_AER\_F from 1 to 0. This flag determines which routine is used to find aerosol layers. 1 = use A\_20s\_aer\_det; 0 = use A\_cld\_lays\_mod

Const\_atm\_mod.f90:

- Changed gi\_cal\_ht\_hi from 26000 to 23000. This is the height of the center of the high calibration band used for 532 calibration.
- 0001155: ANC09 Data Selector for GPS data

Created new PGE, GLAS\_Tick, to create output files from ANC09/ANC32 and GLA03. The resulting outputs will be used for oscillator frequency monitoring. The User Guide has been updated with a new section for this PGE.

- 0001152: Change needed in QAP02 Data Structure

The GLA02 QAP files have been given an enhancement which provides more granularity in the energy distribution histograms.

- 0001122: QAP02 Updates Required to BROWSE Software

Inspected new GLA02 QAP data and find it conforms to expectations from code changes made in Fortran which produces data for QAP. Plots are attached.

- 0001072: WF QA Needs To Be Updated

Updated QAP05 to include iQA100pLSat (percent of packet with low-gain saturation), iQA100pHSat (percent of packet with high-gain saturation), and iQA100pHFSat (percent of packet with high-gain sat+forward scattering) in the along track average, and i\_pcmtLSat (percent of granule with low-gain saturation), i\_pcmtHSat (percent of granule with high-gain saturation), and i\_pcmtHFSat (percent of granule with high-gain sat + forward scattering) in the QA summary record. Initialized all variables to invalid.

Corrected problem in calculation of (WF centroid - centroid of max-amp peak). Corrected QA code to gather skewness and kurtosis data only for WFs with one peak. Updated qapg code to include the new saturation flags. Changed min & max values for histograms of solution sigmas, standard deviation of fit, and (WF centroid - max-amp peak centroid).

- 0001071: GLA13 BergElev not Set

Iceberg elevation parameter in GLA13 was previously not set in the code and had all default values. An initial algorithm has been implemented to compute this height. Although values are now available, they are very sparse. Fine-tuning of the algorithm is anticipated. NOTE: GLA13 includes some land. Iceberg elevation is still computed and reported wrongly for these land flagged data.

- 0001069: 532 Channel Background Computation

See 0001177.

- 0001068: GLA13 GLA02 QA Tweaks

The QAP output for GLA02 has improved resolution for the energy histograms and a minor correction to the expected/processed counts.

- 0000960: Valid lat/lon Produces invalid DEM Elevation

The conditions cited by Jeff are only an explainable anomaly and do not constitute an error. Elevations runs show that the interval in question occurs over a coordinate range of roughly -77.7 lat / 184.6 lon through -82.8 lat / 169.0 lon. The DEM elevations are indeed invalid as reported; however, the entire interval occurs over the Ross Ice Shelf. At the end of the interval the DEM elevations become valid, as expected over the true Antarctic land mass. The etopo30 DEM used as of this entry records an ice shelf as being over ocean, and not land. There is no software or data error.

- 0000952: \_pcnts1, i\_pcnts2 Should Be Changed To Spares

Changed \_pcntSat1 & \_pcntSat2 to \_spare7 & \_spare8. Changes to qapg (to display saturation data from wfQual) should be done on another branch.

GLA05%i\_pcnts1 and GLA05%i\_pcnts2 have been changed to GLA05%i\_spare7 and GLA05%i\_spare8. The online documentation was updated by Dennis and confirmed by LeeAnne Roberts. Code changes confirmed by Steve McLaughlin.

- 0000943: GLA01 Engineering Data needs to Define Values

Added the following comments in the description:

d\_engineering(1) = active detector temperature [T\_detID

if detector=1, T\_detID = GLA00\_prod%CTHW3\_hk(1)%i\_PRTad1C24\_t

if detector=2, T\_detID = GLA00\_prod%CTHW3\_hk(1)%i\_PRTad2C25\_t]

d\_engineering(2) = active digitizer temperature [T\_digID

if digitizer=1, T\_digID = GLA00\_prod%CTHW3\_hk(1)%i\_AD1ADCC19\_t

if digitizer=2, T\_digID = GLA00\_prod%CTHW3\_hk(1)%i\_AD2ADCC20\_t]

d\_engineering(3) = oscillator board temperature

[T\_relay = GLA00\_prod%CTHW3\_hk(1)%i\_OscBdC11\_t]

d\_engineering(4) = Fiber Box temperature

[T\_fb = GLA00\_prod%CTHW3\_hk(1)%i\_PRTfboxC29\_t]

d\_engineering(5) thru d\_engineering(12) TBD. All temperatures are in Celsius X 100.

- 0000903: GLAS 532 nm PBL and Aerosol Layer Heights (GLA08)

See 0001177

- 0000902: GLAS 532 nm Cloud Layer Heights (GLA09)

Changes to threshold computations to reduce false positives were made in the following files: A\_cld\_lays\_mod.f90, A\_cld\_det\_mod.f90 and A\_cld\_grd\_det\_mod.f90:

- 0000779: WFMgr on Integration Branch crashes with out of bounds error

When I ran this using LeeAnne's setup, the error did not occur. Thus, this appears to be due to an error in the configuration file. Can't reproduce the problem.

- 0000752: GLAS Telemetry Changes

GLA00 changes detected are as follows (APID55 only):

< integer (kind=i1b) :: i\_spare50\_4(8) !Spare in telemetry

---

> integer (kind=i4b) :: iCD\_PWaccum !CD PW Limit Violation counter

> integer (kind=i1b) :: iCD\_PWlong !CD Long PW Violation counter

> integer (kind=i1b) :: iCD\_PWshort !CD Short PW Violation counter

> integer (kind=i1b) :: iCD\_PWmsb !CD Short PW MSB

> integer (kind=i1b) :: i\_spare50\_4(1) !Spare in telemetry

Made documentation changes to the Product Database for GLA03. The changes are:

integer (kind=i1b) :: i\_spare55\_4 (8,4)<---replace

integer (kind=i4b) :: iCD\_PWaccum (4)<---New addition

integer (kind=i1b) :: iCD\_PWlong (4)<---New addition

integer (kind=i1b) :: iCD\_PWshort (4)<---New addition

integer (kind=i1b) :: iCD\_PWmsb (4)<---New addition

integer (kind=i1b) :: i\_spare55\_4 (1,4)<---changed size

- 0000717: GLAS\_Atm is Generating an IEEE Overflow for Certain Data

The IEEE overflow was traced to a line of code in A\_20s\_1064\_det\_mod.f90 that computed the average and standard deviation of a few km of atmospheric profile. If all the bins in this few km were invalid, the std deviation was calculated as invalid. The std deviation was then used to compute a threshold and this would cause the over-

flow. A check on the magnitude of the std deviation was added to catch this condition.

- 0000673: Running without pad and pod in for Elevation mgr gives Different Results

Running elevations without the PAD and POD now provides effectively the same results as running with them, provided that the PAD and POD are the same ones used when generating the original GLA05 with waveforms software.

- 0000665: L1A Transmit Energy per Shot

Modified L1A to calculate transmitted energy (for GLA02) at 40Hz instead of repeating the value for shot 1 forty times.

- 0000611: GLA05 QA Problems in Release 11+

Updated QAP05 to include iQA100pLSat (percent of packet with low-gain saturation), iQA100pHSat (percent of packet with high-gain saturation), and iQA100pHFSat (percent of packet with high-gain sat+forward scattering) in the along track average, and i\_pcmtLSat (percent of granule with low-gain saturation), i\_pcmtHSat (percent of granule with high-gain saturation), and i\_pcmtHFSat (percent of

granule with high-gain sat + forward scattering) in the QA summary record. Initialized all variables to invalid. Corrected problem in calculation of (WF centroid - centroid of max-amp peak). Corrected QA code to gather skewness and kurtosis data only for WFs

with one peak. Updated qapg code to include the new saturation flags. Changed min & max values for histograms of solution sigmas, standard deviation of fit, and (WF centroid - max-amp peak centroid).

- 0000601: Unexpected Latitudes in GLA12-15 Along-Track Records

This problem is apparently resolved on the integration branch. For a GLA12 qap file generated on the main branch only,

```
IDL> data=qapread('/home/jack/
GLA12_012_1102_002_0021_0_01_main_0001.qap')
```

```
IDL> print,min(abs(data.alongtrack.dqa100lat))
```

```
37.384362
```

whereas the same run using code from integration gives

```
IDL> data=qapread('/home/jack/
GLA12_012_1102_002_0021_0_01_integ_0001.qap')
```

```
IDL> print,min(abs(data.alongtrack.dqa100lat))
```

```
69.044922
```

It is not clear which change fixed this problem. None of the ones listed in the history for elevmgr\_mod.f90 since the last change on main address it directly.

- 0000518: Inconsistent/incorrect Determination of end of QAP Averaging period: GLA05

The production of the GLA05 QAP file was amended so that it utilizes standard timing software employed for other GLA QAP products.

- 0000501: GLA01 QA Averages include Bad Data

GLA01 QAP data has been updated to remove statistics based on spurious additions from invalid records, thus improving the accuracy and validity of the QA data available.

- 0000430: Global avg std dev Set to Invalid if all values of Parameter are the Same

A/D receiver gain statistics are now available in the GLA01 QAP file.

#### **Changed ANC07 Parameters:**

##### **ANC07\_02**

changed GI\_AER\_TOP\_HT from 36000 to 30000

changed GI\_CALC\_AER\_F from 1 to 0

changed GI\_CC\_ELIM\_F from 1 to 0

##### **ANC07\_05**

changed GI\_G\_USEDDBG from 2 to 1

changed GD\_IR\_MAXLID from 255 to 500

Added D\_QA\_G\_NRG\_HIST and D\_QA\_IR\_NRG\_HIST

Removed D\_QA\_NRG\_HIST

#### **5.4.16 GSAS v3.8.1 Release Notes**

GSAS 3.8.1 contains fixes and minor modifications for L1A, Atmosphere, Waveform, and Elevation processes and products.

For L1A, the following changes were made:

- Fixed a problem where i\_g\_IntRet on GLA02 was always negative.

For Waveforms, the following changes were made:

- Fixed problems unconverted by a change in waveform compression parameters.

For Elevation processes, the following changes were made:

- Replaced TrshRngOff with SigBegOff on GLA14.

For Atmosphere, the following changes were made:

- Enhanced PBL Height and Elevated Aerosol Layer Detection routines.

Other, more general fixes include:

- The ANC13 geoid file was updated to the EGM96 geoid referenced to the TOPEX/Poseidon ellipsoid.

### **Product Format/Definition Change Summary**

GLA14:

TrshRngOff was replaced by SigBegOff

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v38\\_products/](http://glas.wff.nasa.gov/v38_products/).

### **Known Problems**

GLA16 still not supported.

Additional parameters need to be added to QAP03.

LRS subject change algorithm needs to be implemented.

SIRU sample time correction algorithm needs to be implemented.

More atmosphere changes are pending.

QAP05 lists all waveforms as always valid – this is a mistake, probably in the total number of waveforms

Lots of other QA tweaks needed.

### **Release Information**

The ClearCase label for this release is RELEASE\_3.8.1.

The release date is February 25, 2004.

Version numbers have been updated to “V3.8.1 February 2004” for the following:

- atm\_lib
- l1a\_lib
- GLAS\_L1A
- GLAS\_Alt
- GLAS\_Atm
- anc07\_02
- anc07\_04
- anc45\_01-15

This should be verified during operation by checking the version information in the appropriate ANC06 files.

**Detailed Change Notes**

- 0001328: Update ANC45 Release Numbers to 16

Updated ANC45 VersionID to 16.

- 0001261: QABrowse Problems

Fixed problem with case of the file extension on HDF output files. Fixed various problems seen in GSAS 3.8b2 ACCTEST products.

- 0001326 : Atm dies with IEEE underflow in onepass\_accumulate\_simple

Initialized the QA structure used in A\_QA\_G8\_11.

- 0001325: Add Description of anc13 (Geoid) to Database

Updated the description of ANC13 in the product database.

- 0001318: Trouble reading GLA04 in standalone F90 Product Readers

Corrected an error in the GLA04 standalone product reader.

- 0001311: Replace i\_TrshRngOff with i\_SigBegOff, on GLA14

The TrshRngOff variable in GLA14 was replaced by SigBegOff, the signal beginning offset as calculated using the alternate (land) parameters. Product database was updated accordingly.

- 0001307: R Type Compression is Not Handled Correctly in WFs

Corrected waveform problem in processing data with R type compression.

Changed nSig1 from 7.5 to 4.5

- 0001301: Compressed Waveforms Are Not Handled Correctly In WFMgr

Fixed error in fitting waveforms that have two different compression ratios.

- 0001122: QAP02 Updates required to BROWSE Software

Browse software was updated to work with changed QAP02 parameters.

**Changed ANC07 Parameters:**

ANC07\_02

changed GD\_CRAT\_THR20 from 1.10d1 to 1.0d1

ANC07\_04

changed D\_NSIG1 from 7.5d0 to 4.5d0

### 5.4.17 GSAS v3.9 Release Notes

GSAS 3.9 contains additional functionality for GLA04 L1A, significant improvements in Atmosphere processing, improvements in waveform computations, and significant improvement in Quality Assessment functionality.

For L1A, the following changes were made:

- Improved GLA03 Quality Assurance Product (QAP).
- Improved GLA04 Gyro time tagging.
- Implementation of GLA04 LRS tracker data swap logic.
- Addition of 6 temperatures to the GLA04\_LRS product.
- Implemented 532 background as a function of height.
- Flag set to indicate SPCM off condition.

For Waveforms, the following changes were made:

- Potentially improved fitting of saturated waveforms. Constants were modified for both standard and alternate fitting. Some code changes made for alternate fitting.
- Improved QAP05.
- Fixed bug in number of peaks used.
- Optional processing for saturated waveforms. These options are currently disabled for operations.

For Atmosphere, the following changes were made

- Substantially improved PBL height retrieval (GLA08).
- Improved cloud layer detection from 1064 channel.
- Implemented a time dependent calibration for 1064

Other, more general fixes include:

- More protection for floating point exceptions.
- Documentation corrections.
- Across the board QAP and browse improvements.

#### Product Format/Definition Change Summary

GLA01:

i\_RecNrgAll\_EU - changed max value

i\_RecNrgLast\_EU - changed max value

GLA03:

Replaced existing spare55 with:



CD\_PWaccum i4b(4)

CD\_PWlong i1b(4)

CD\_PWshort i1b(4)

CD\_PWmsb i1b(4)

changed spare55\_4 to i1b(1,4)

GLA04\_LRS:

lrs\_flag - added bit 5

lrs\_flag - added bit 6

Replaced 12 spare bytes with six 2-byte temperatures as follows:

i\_lrs\_spare1 (i2b) (byte offset 482) changed to i\_LPAC13\_t1 (i2b)

i\_lrs\_spare2 (i2b) (byte offset 1114) changed to iF1LTRSRSC26\_t (i2b)

i\_lrs\_spare3 (i8b) (byte offset 6368) changed to iF2LTRSRSC27\_t (i2b),

i\_TsPMir\_t (i2b), i\_TsSMir\_t (i2b),

i\_srs\_ff\_optics\_t (i2b)

GLA05, 06, 12-15:

i\_PADPoint - long description change

i\_PODFixedPos - long description change

WFqual - Description change to bits 16 and 17

i\_ldElv - load tide description change

GLA13:

i\_BergElev - description change (GLA13)

GLA14:

i\_TrshRngOff - replaced by i\_SigBegOff (GLA14)

ANC13 (Ancillary file):

anc13 (Geoid) - add description

ANC33 (Ancillary file):

Added two new fields:

d\_siru\_e (the initial slope for the SIRU VTCW correction).

d\_siru\_e2 (the secondary slope for the SIRU VTCW correction).

The latest product formats/descriptions will be available at

[http://glas.wff.nasa.gov/v39\\_products/](http://glas.wff.nasa.gov/v39_products/).

**Known Problems**

GLA16 still not supported.

Additional parameters need to be added to QAP03.

Some ANC45 metadata changes are outstanding.

More investigation into processing of saturated waveforms is needed.

High definition DEM needs to be integrated into the GSAS code.

532 background for bright daylight scenes still not 100% correct. This causes the data to be poorly calibrated which affects all L2 results.

Cloud/aerosol discrimination for polar latitudes incorrect. Many clouds are labeled as aerosol in polar regions. Elsewhere classifications are better, but not perfect (especially for multiple layers where lower layer is attenuated by upper layer).

The quality flag for PBL height should be  $\geq 2$  to insure a viable PBL height retrieval.

Clouds detected from the 1064 channel may actually be aerosol layers (no 1064 cloud/aerosol discrimination has been implemented as yet).

QAP05 lists all waveforms as always valid – this is a mistake- probably in the total number of waveforms.

Lots of other QA tweaks needed.

**Release Information**

The ClearCase label for this release is RELEASE\_3.9.

The release date is May 5, 2004.

Version numbers have been updated to “V3.9 April 2004” for the following:

- lib\_atm
- lib\_l1a
- lib\_wf
- lib\_elev
- lib\_anc
- lib\_cntl
- lib\_file
- lib\_math
- lib\_platform
- lib\_prod
- GLAS\_L1A
- GLAS\_Alt

- GLAS\_Atm
- GLAS\_Meta
- GLAS\_Tick
- anc07\_00
- anc07\_02
- anc07\_04
- anc07\_05
- anc45\_01-15

This should be verified during operation by checking the version information in the appropriate ANC06 files.

#### SNC Files

New versions of the ANC07\_00, ANC07\_05, and ANC45 data files are required.

A new ANC33 file with appropriate field additions is also required.

ANC07/01 global constants file should be an input to CreateGran\_util and RefOrbit\_util. The keyword is IN\_ERRORFILE=.

#### Detailed Change Notes

- 0001493: reforbit\_util and createGran\_util are not Using the Ellipsoid

Reforbit\_util and createGran\_util were modified to read in the ellipsoid parameters from the global constants file. This change affects ANC22, ANC28, and ANC43.

NOTE: SDMS will be impacted by this change.

ANC07/01 global constants file should be specified in the control file with keyword IN\_ERRORFILE=.

- 0001488: Update F90 "SCF" Readers for Rel 17

Updated SCF readers to reflect Release 17 product changes.

- 0001485: GLA04-02 LRS needs Temperature Data Added

6 temperature values were added to the GLA04 LRS product. These are: i\_LPAC13\_t1 (Laser Profiler Array (LPA) Temperature 1 Ch 13), iF1LTRSRSC26\_t (PRT, Face 1LTR to SRS Temperature Ch26), iF2LTRSRSC27\_t PRT (Face 2 LTR to SRS Temperature Ch27), i\_TsPMir\_t (Telescope Region 0 Primary Mirror Temperature), i\_TsSMir\_t (Telescope Region 1 Secondary Mirror Temperature) and srs\_ff\_optics\_t(SRS First Fold Optics Temperature).

- 0001455: Change def of bit in i\_elvFlg

Changed definition of i\_ElvFlg for bit 7, "TBD" changed to "1 = Gain > flag value, indicating probable cloud contamination"

- 0001453: Add Code to L1A Mgr which skips Unneeded Data

Added code which skips data processing till 1 minute before the earliest output time.

- 0001452: SCF Product Readers readme Update

SCF Product Readers "README" file was updated to remove references to the SCF, website.

- 0001443: Units/scale Error in GLA05 Product Description

Corrected documentation regarding scales and units for d\_parm and d\_solnSigmas.

- 0001435: Update ANC45 Release Number and Version Description

Updated the VersionID in the ANC45 files to 17. Updated the Version Descriptions as follows:

For products GLA01-GLA05, GLA07-GLA11 = "GSAS version 3.9, Geoid reference to TOPEX, POD version 5, PAD versions differ, see release notes"

For products GLA06, GLA12 -GLA15 = "GSAS version 3.9, Geoid updated to be referenced to same ellipsoid as elevation, POD version 5, PAD versions differ, see release notes."

- 0001423: An Array in W\_CharTrPulse has Wrong Dimension

In W\_CharTrPulse, d\_trTime(giMxGates) was corrected to be d\_trTime(giMaxTrGates).

- 0001416: Change QAPG to Conform with Mantis 1257 and 1344

The definitions of two flags in L\_WFQual (which is in the product files for GLA05, 6, and 12-15) was changed. The invalid wf flag is set only if the waveform is fill. The no signal flag is set only if there IS a waveform (not fill) which is never above threshold.

- 0001406: QABrowse CATCH Block Commented Out

QABrowse should now correctly report an exit status.

- 0001405: Definition of load tide Inaccurate

Description corrected to say: "The load tide elevation applied to each shot. Element i (i=1,4) is applied to the ten shots 10\*i-9 to 10\*i (1-10, 11-20, etc.)."

- 0001401: Definition change in L\_WFQual Flag

The PDF description has been changed on bits 16 and 17 for the WFQual flag in GLA05.

- 0001398: QAP06 Browse Problems in Release 16.

No description of fix provided.

- 0001396: HDF files for GLA02 and GLA05 are Blank

This required coordinating the release number in the control file.

- 0001371: Need gi\_fname\_len Increased from 80 for SCF

Increased the maximum filename length to 255.

- 0001366: ANC32 roll logic fails when Processing Multiple Days in One Job

The rollover logic for ANC32 was fixed to handle processing multiple days in a single job.

- 0001355: PAD and POD Long Description Documentation Change

(changes are in caps)

i\_PADPoint Description: Unit vectors giving the pointing direction of the laser with respect to the GLAS optical bench axes in the ICRF reference frame, one vector for each of the 40 shots, AT THE SHOT (TRANSMIT) TIME. Each component is composed of 2 4-byte items.

i\_PODFixedPos Description: Spacecraft position vectors in ICRF of the laser point of reference on the spacecraft, one vector for each of the 40 shots, AT THE BOUNCE(TRANSMIT PLUS TRANSIT) TIME. Each element is composed of 2 4-byte items. The first is m and the second is millimeters.

- 0001344: Change Definition of Nosignal flag in L\_WFQual

The definitions of two flags in L\_WFQual (which is in the product files for GLA05, 6, and 12-15) was changed. The invalid wf flag is set only if the waveform is fill. The nosignal flag is set only if there IS a waveform (not fill) which is never above threshold.

- 0001340: Update QABrowse and read s/w for Changes to QAP03

QABrowse was modified to handle new QAP03 summary data record format.

- 0001339: GLAS\_Atm bombs in c\_beam\_sun\_ang

Problem happens when range to peak of return is invalid for a few records at the very beginning of the GLA02 file. The d\_spot\_elev parameter had not been initialized and contained random information, causing the Beam\_sun\_ang module to hit an overflow. The same issue occurs later in the data set, but an old (and incorrect) value of d\_spot\_elev prevented an abnormal ending. The ATM Mgr has been modified to fix the error.

- 0001327: Add Documentation to onepass\_average\_mod.f90

Added internal documentation to onepass\_average\_mod.f90

- 0001287: Release 15 L\_Atm is generating Errors at 40/sec rate

The fix was to put the 532 processing code in an if block that is tested for the number of SPCM's enabled. If this value is < 1, a call to GLAS\_Error is made (at once per second) and the 532 processing code is not executed. This will mean that when the SPCM's are not enabled, the 532 data produced by L\_Atm\_mod (GLA02) will be

invalid. Prior to this change, the data would have been no good, but most likely not invalid (possibly all zeroes).

- 0001288: Write\_L1A gives Confusing Error Message

Fixed an error where Write\_L1A reports g\_time in the error instead of the time actually being checked.

- 0001268: PBL Height / Elevated Aerosol Layer Detection Enhancement

GLA02%i\_g\_IntRet calculation fixed.

False positives for aerosol layer heights above 20 km reduced/eliminated.

Improved 1064 calibration via a time dependent calibration coefficient based on offline analysis of 532 and 1064 backscatter from cirrus clouds and ER-2 validation under flight comparisons.

Improved 1064 cloud layer detection at 1 and 4 second resolution. Reduction in false positive occurrence.

Processing (Level 2) of 532 channel is turned off when the data quality is severely reduced due to low laser energy and high background, but 1064 processing continues.

Much improved Planetary Boundary Layer (PBL) height retrievals. Reduction of falsepositives and the refinement of the PBL quality flag (1-14, where 14 is highest quality or highest confidence).

Elevated aerosol layers that were reported at or below the PBL top have been eliminated.

Improved cloud/aerosol discrimination

Error in flag packing for GLA10 and 11 corrected and excessive calls to GLAS\_Error on divide by zero condition eliminated (Mantis 1094 problem report). Excessive calls to GLAS\_Error when SPCM's are not turned on eliminated (Mantis 1287 problem report).

- Turned on flag to eliminate calibration points calculated during daylight.
- 0001260: GLA10 and 11 Atmospheric Data Product Refinement

A\_aer\_opt\_prop

- changed decision tree for tropospheric and stratosphere layer determination
- labeled lower\_aerosol layer loop for clarity
- reset backscatter and extinction profiles to prior settings after call to A\_forward\_inversion for msf purposes only (2 occurrences, helps saturation settings)
- eliminated need to call GLAS\_ERROR during 1-sec, 4-sec, and 20-sec att. bs profile averaging and sdev

- set optical depth of layer to invalid if any extinction in layer is invalid
- changed saturation check from (i\_index .lt. 5) to (i\_index .ne. 1) due to change in S. Palm's GLA07 output A\_aer\_inits \* modified aerosol and cloud sval use flags so both are initialized as 15

#### A\_cld\_opt\_prop

- fixed integer overflow condition in aerosol layer above cloud algorithm
- d\_cld\_trans was wrongly indexed with i\_c, changed to i\_t
- Set optical depth for layer to invalid if any extinction in layer is invalid
- A\_forward\_inversion
- Eliminated need to call GLAS\_ERROR routine when calculating d\_xval
- Added more validity tests to inputs of inversion loop
- Set optical depth to invalid if i\_flag > 0

#### A\_opt\_thin

- Changed thresholds of realistic Sratio from  $1 \leq S \leq 130$  to  $5 \leq S \leq 120$
- Changed SNR threshold d\_snr\_thresh from .40 to .25

#### A\_backward\_inversion

- Added checks for out of bounds conditions on variables Constants
- Changed gd\_trans\_lbnd from .12 to .01
- 0001257: QA05 # Valid Returns looks Odd

The % valid is now below 100 and showing different values for alternate and standard parameterizations.

- 0001244: QAP03 Percent Missing Data has Negative Values

QAP03\_mod was modified to make Percent Missing Data be equal to zero if the value was negative. Negative values were being received because the actual number of apid's was more than the expected. A call to GLAS\_Error was also added when more than one packet per apid was processed over the number expected.

- 0001228: Add Gain Flag to GLA06,12-15

Added gain flag to GLA06, 12-15.

- 0001186: LRS Subject Change

Implemented code to detect when VT0 tracks the wrong image. The code detects the mistracking and swaps the appropriate data. The detection algorithm and associated constants were provided by the instrument team.

- 0001053: Elev Mgr Error in calc of N Final Peaks for QAP06

Fixed a problem where number of alternate peaks was used instead of number of standard peaks.

- 0000840: Release 12 GLA06,12-15 Problems Discovered in QA Data

Various problems were fixed for the GLA06, 12-15 QA.

- 0000767: Examine Alternate Fitting for Saturated Waveforms

Special Processing:

Changed fitting procedure to use a different method to fit (standard parameters only) waveforms that have saturation (this method conserves the total area of the waveform measured above the noise from signal begin to signal end). For version 17, this special processing method has been turned off by setting I\_USEHS\_PROC in anc07\_001\_01\_0004.dat to 0.

I\_USEHS\_PROC may also be set to 1 to apply special processing only to low gain saturated waveforms (standard only); 2 to apply special processing only to high gain saturated waveforms (standard only); or 3 to apply special processing to any saturated waveforms (standard only).

Normal Processing:

The following changes were implemented for both normal and special processing.

767: Implemented laser-dependent criteria for determining high and low gain saturation. In anc07\_001\_01\_0004.dat, updated D\_SATUR\_NRG (Min Echo pulse energy in femto-joules to imply low gain saturation) from 15.0D-15 to 11.0D-15.

1127: Changed the way the peak sigma is constrained during the fitting process. Fixed calculation of second-try estimated sigma. Fixed logic so that if the first fit failed, and if there was a second-try estimate, then a second fit was attempted. Removed some variables that are no longer used.

1423: Corrected array dimension in W\_CharTrPulse.

- 0000486: SIRU (GYRO) Sample time is not Correct

The GYRO sample time computation is improved by including the siru time tag and performing a "sync" with the internal clock.

- 0000468: Implement QAP03 Granule Stats

The Granule statistics below were implemented in QAP03\_mod.f90

Implement the following granule stats (max,min,avg,stdev) for:

- the difference between the laser fire command time and the laser fire acknowledge time.
- the difference between the spacecraft time (BVTCW) of the spacecraft time and position packet and the GLAS MET of the spacecraft time and position packet.



- sum of the Post-Delay pulse waveform bin values (32 bins); average and stdev only
- the peak of the Post-Delay laser pulse
- the pulse width of the Post-Delay laser pulse
- the peak of the four OTS laser pulse
- the pulse width of the four OTS laser pulse

The QAP03 file lists these at the bottom of the summary statistics section.

- Changed ANC07 Parameters:

#### ANC07\_02

changed GD\_CC\_NUM\_STD from 1.3d0 to 2.0d0.

changed GD\_DISCRIM\_THR (array of values).changed GD\_IR\_LMCALCOF from 4.20d1 to 5.20d1.

changed GD\_PBL\_THR\_FTR from 0.30d0 to 0.40d0.

changed GI\_CC\_ELIM\_F from 1 to 0.

#### ANC07\_04

replaced saturation parameters D\_PSAT\_STOP1, D\_PSAT\_STOP2, D\_PSAT\_SPEC1, and D\_PSAT\_SPEC2 with I\_USEHS\_PROC, D\_AALPHA, D\_ABETA, and D\_AGAMA.

changed I\_OFFSETB1 from 12 to 50.

changed I\_OFFSETB2 from 10 to 50.

changed I\_OFFSETTE1 from 12 to 50.

changed I\_OFFSETTE2 from 10 to 50.

replaced I\_SATAMP with I\_SATAMP1, I\_SATAMP2, and I\_SATAMP3.

replaced I\_SATUR\_GAIN with I\_SATUR\_GAIN1, I\_SATUR\_GAIN2, and I\_SATUR\_GAIN3.

replaced D\_SATUR\_NRG with D\_SATUR\_NRG1, D\_SATUR\_NRG2, and D\_SATUR\_NRG3. (Changed value from 15.0d-15 to 11.0d-15)

replaced D\_MINNRG\_SAT with D\_MINNRG\_SAT1, D\_MINNRG\_SAT2, and D\_MINNRG\_SAT3.

replaced I\_MAXGAIN\_SAT with I\_MAXGAIN\_SAT1, I\_MAXGAIN\_SAT2, and I\_MAXGAIN\_SAT3.

replaced D\_WIDTHPK\_SAT with D\_WIDTHPK\_SAT1, D\_WIDTHPK\_SAT2, and D\_WIDTHPK\_SAT3.

replaced D\_MINSKEW\_SAT with D\_MINSKEW\_SAT1, D\_MINSKEW\_SAT2, and D\_MINSKEW\_SAT3.

changed D\_V0NS1 from 0.1d0 to 1000000.0d0.

changed D\_V0NS2 from 0.1d0 to 1000000.0d0.

added D\_AREAV0 = 0.1d0

added d\_GainAlertLevel = 30

#### ANC07\_05

changed GD\_NRG\_THR1 from 1.0D-3 to 0.5D-3.

changed GD\_GYRO\_TIME\_LAT from 0 to 0.001763d0

Added GD\_LIM\_VT1CENTR = 850.0d0 920.0d0

Added GD\_LIM\_VT1CENTC = 850.0d0 900.0d0

Added GD\_LIM\_VT2CENTR = 930.0d0 975.0d0

Added GD\_LIM\_VT2CENTC = 1175.0d0 1215.0d0

Added GD\_VAL\_VT1CENTR = 830.0d0 950.0d0

Added GD\_VAL\_VT1CENTC = 820.0d0 950.0d0

Added GD\_VAL\_VT2CENTR = 900.0d0 1060.0d0

Added GD\_VAL\_VT2CENTC = 1100.d0 1260.0d0

Added GD\_LIM\_VT1NRG = 1500.0d0

Added GD\_LIM\_VT2NRG = 75.0d0

Added GD\_LIM\_VTC\_RATE = 8.0d0

Added GD\_LIM\_VTR\_RATE = 8.0d0

Added GD\_LIM\_VT\_SWAP\_T = 2.0d0

Added GI\_DC\_OFFSET = 30

### 5.4.18 GSAS v4.0 Release Notes

GSAS 4.0 contains a time tag correction for the GLA04 gyro data, improvements in Atmosphere processing, improvements in waveform computations, and the addition of selected atmosphere parameters onto the elevation products.

For L1A, the following changes were made:

- Changed the GLA04 gyro time offset by adding -50ms to the GLA04 gyro time.
- Changed units/min/max of ADdetOutGn and ADdetRetGn on GLA03.

For Waveforms, the following changes were made:

- Fixed error that was that was throwing out some standard and alternate fits that were flagged as poor fit.
- Corrected condition where alternate fits were not attempted on some waveforms that had a standard fit.
- Fixed condition where there was no fit for some transmitted pulses.

For Elevation processes, the following changes were made:

- Added atmosphere parameters to the elevation products.
- Corrected the geoid heights on the elevation products. They are now properly referenced to the GLAS ellipsoid in a mean-tide system.
- Correctly set bit 40 of the range use quality flag.

For Atmosphere, the following changes were made:

- Fixed problems with the eta factor calculation (this factor the optical depth and extinction for the effects of multiple scattering), Range Delay (see 1607 below) and Lat/Lon in GLA10/11.
- Fixed bug in multiple scattering warning flag when layer when optical depth of a layer could not be calculated.
- Fixed bug in range delay and range uncertainty when no layers are sensed.
- Modified the threshold for ground detection in GLA09 to reduce occurrence of false positives
- Changed the 1064 channel calibration value for laser 1 data from 42 to 53. Calibration of 1064 now very good and verified by independent coincident measurements.
- Fixed bug in code that prevented the 1064 cloud layer detection routine from executing when the SPCMs (532 channel) were turned off. Other, more general fixes include:

Other, more general fixes include:

- Updated ANC45 versionID and parameter names.
- General code cleanup.
- General QA/Browse fixes.

### **Product Format/Definition Change Summary**

GLA03:

i\_ADdetOutGn : units changed to counts; min/ max changed to 0/255.

i\_ADdetRetGn : units changed to counts; min/ max changed to 0/255.

GLA05:

i\_WFqual: Bits 20 and 21 descriptions changed.

**GLA07:**

SolAng : units changed to microdegrees; min/max changed to -90000000/90000000; scale changed to 1.0d-6

**GLA06, 12-15:**

Replaced spares with the following atmosphere parameters: i\_MRC\_af from GLA09; i\_cld1\_msf, i\_erd, and i\_rdu from GLA11.

Replaced spare with i\_atm\_avail (flag to indicate availability of atmosphere parameters)

The latest product formats/descriptions will be available at [http://glas.wff.nasa.gov/v40\\_products/](http://glas.wff.nasa.gov/v40_products/).

**Known Problems**

GLA16 still not supported.

GLA09 and GLA08: Cloud Aerosol discrimination usually results in layers misidentified as aerosol when they should in fact be cloud. Problem is most severe in the high latitude regions and over the poles, and in regions of multiple cloud layers where signal attenuation from upper layer makes the lower layer 'look' like aerosol.

GLA07: Background computation problem in areas of very bright light cause signal to be poorly calibrated in some instances where the background is high.

**Release Information**

The ClearCase label for this release is RELEASE\_4.0.

The release date is August 16, 2004.

Version numbers have been updated to "V4.0 July 2004" for the following:

- all libraries
- GLAS\_L1A
- GLAS\_Alt
- GLAS\_Atm
- GLAS\_Meta
- anc07\_02
- anc07\_05
- anc45\_01-15

This should be verified during operation by checking the version information in the appropriate ANC06 files.

**SMDS Impact**

The distribution tarfile is on [glasdev.wff.nasa.gov](http://glasdev.wff.nasa.gov) at the following location:

/glasdev1/v3/dist/gsas\_V4.0.tar.Z.

## ANC Files

New versions of the ANC07\_00, ANC07\_05, ANC13, and ANC45 data files are required.

## Bundle Changes

GLA09 and GLA11 are now optional inputs to elevation processing. We would like to use GLA09 and GLA11 as “standard” inputs, but have a bundle available which would run manually without them.

## Compilation

All libraries and binaries should be recompiled using the top-level Makefile. IMPORTANT: due to internal changes in the makefiles, SDMS MUST use the command "make runtime" to ensure the software is made without debug flags.

The process for making the libraries and binaries is as follows (NOTE: SDMS ONLY!!)

```
cd /install_dir/gsas_v4.0
```

```
make runtime
```

```
make install
```

Note : developers should not use the above procedure. This procedure is for SDMS only!

## Detailed Change Notes

### **0001679: WFs Crashes In W\_CalcFnP**

Added check to avoid dividing by zero in W\_LsqFit\_mod.

### **0001675: ElevMgr Should Check NoFit Flag**

Added a check for noFit before using range offsets from gla05.

### **0001665: Some WFs Have No Alternate Fit**

Changed code so that the no-leading-edge and no-trailing-edge flags are not set if there is a signal.

### **0001659: Calibration change for 1064 Atmosphere for laser 1**

- 1) The 1064 nm calibration constant was 25% too low. A value of 42 was hard coded into the GSAS code and was changed to 53. The 53 number is based on extensive analysis of coincident CPL (Cloud Physics Lidar) data from Feb-Mar, 2003. This change was made in the routine "A\_cal\_cofs\_mod"
- 2) On GLA11:
  - Re-defined range delay to altitude offset for altimetry by dividing by -2.0.
  - Kept uncertainty positive by multiplying by -1.0.

**0001654: Solar Angle Units need Changing in Product Variable Database**

GLA07 parameter i\_SolAng has been changed.

Prod Units: millidegrees chg-to microdegrees

Prod Min: 0 chg-to -90000000

Prod Max: 360000 chg-to 90000000

Alg Scale: 1.0d-3 chg-to 1.0d-6

**0001653: GLA07 SolAng Change**

Superceded by 0001654.

**0001651: GLA03 Return Gain Problem**

On GLA03, the i\_ADdetOutGn\_v and i\_ADdetRetGn the units were changed to counts and min/ max changed to reflect counts.

**0001650: Problem while running L1A on ACCTest**

The problem was a divide by zero. The parameters "d\_background\_avg\_lower" and "d\_background\_avg\_upper" were zero when there are no SPCM's enabled (as is the case for all of laser 1). Added checks to prevent recurrence of the problem.

**0001649: Failed browse01 job 259345**

When the input x vector had only one point, the program bombed when evaluating XGood[1:\*.]. Added code to take the other branch of the IF block including this statement.

**0001646: Online Documentation of i\_wfQual in GLA05 Needs To Be Changed**

Documentation for i\_WFqual flag in GLA05 has been changed. Bits 20 and 21 descriptions changed .

**0001642: Range delay is not calculated correctly when optical depth is invalid.**

The modifications clean up the parameters that are passed to the altimetry products when inputs are not available.

**0001640: GLAS\_Alt elevations bombs with SIGFPE in calcsoloc:calcangle**

This error was created due to an inconsistency between the WF Flags and the GLA05 data. Fixes in the waveform processing code alleviated this problem.

**0001639: Atmosphere dies with SIGFPE**

Problem was that no ANC40 (std atmosphere) was input to the process. While the code certainly does not provide adequate checks, the lack of an ANC40 should be caught an unresolved Mantis item which adds input sanity checking to atmosphere processing.

**0001633: Release 18 anc45 and ESDTs**

Updated anc45 to reflect release 18 data products and create ESDTs.

**0001620: GLA06 d\_ldRngOff has impossible value**

Changed WFMgr so that d\_centroid is not set to invalid unless there is no signal.

0001615: i\_rng\_UQF (i\_RngOffQF) on GLA06 may be bad in 40th shot

Fixed array indexing in i\_RngOffQF. In W\_Assess, corrected setting of the l\_WFqual flags gwi\_noSig1, gwi\_noSig2, gwi\_noLeadEdg1, gwi\_noTrlEdg1, gwi\_noLeadEdg2, and gwi\_noTrlEdg2.

0001609: Atmosphere flags added to elevation products

Added the following atmosphere parameters to GLA06 and 12-15: i\_MRC\_af from GLA09; i\_cld1\_msf, i\_erd, and i\_rdu from GLA11. The i\_MRC\_af flag is the number of cloud layers found at 1 second resolution. This will be the sum of the number of layers detected from the 532 channel and those detected from the 1064 channel. This means that if the 532 channel is not operational, this parameter would still contain the number of cloud layers detected from the 1064 channel. See 1607 below for a description of the parameters: i\_cld1\_msf, i\_erd, and i\_rdu. Added a flag to indicate the availability of atmosphere data to GLA06 and 12-15: i\_atm\_avail. Fixed code in ReadData such that the data would not be set to invalid after the first second if a record-duration was greater than a second.

0001608: Some Poorly Fit Waveforms Are Shown As Not Fit

Fixed error in code that was throwing out poor fits. Fixed error in code that was not setting poor-Fit flags. The poorFit flags are now set if the standard deviation of fit is greater than a number specified in anc07\_0004. Changed the no-signal flag to be set if there is no leading edge OR no trailing edge (instead of AND). If the fit is the estimated fit, then the solution sigmas are set to invalid.

0001607: Add GLA11 cloud parameters to elevation products

Placed two parameters from GLA11 on the elevation data. These are the "multiple scattering warning flag" and the "range delay." The multiple scattering warning flag, which ranges from 0 to 15, indicates the potential severity of the multiple scattering effect due to cloud and/or aerosol layers on the altimetry result. A value of 0 indicates no or very little effect, and 14 is the greatest potential multiple scattering effect. A value of 15 means that cloud layers were present, but that their effect on multiple scattering could not be quantified. This usually happens with thick cloud layers that totally attenuate the beam. In these instances, it is unlikely to have a ground return suitable for altimetry. The range delay parameter is an attempt to quantify the effect of multiple scattering on the altimetry range result. It is a potential way to correct the altimetry range for multiple scattering. It is in millimeters and should be added directly to the range to correct it (since it is always negative or zero). Note that this number is calculated from a number of inputs, not all of which can be deduced from the atmospheric channels. The largest uncertainty is the particle size of the scattering layer which is obtained from a crude lookup table. Since the actual particle size of a scattering layer may differ substantially from that obtained from the table, and the

range delay depends significantly on the particle size, the values of the range delay can have significant errors. See 0001609.

**0001606: Metadata science QA flag set to "Failed"**

Changed the science QA to "inferred passed".

**0001592: Error in special processing in waveforms**

Corrected the partial derivative of the area with respect to location. This is used in fitting satu-rated waveforms during special processing.

**0001590: No Fit For Some Transmitted Pulses**

Added a parameter (nSig) to anc07 which is used to determine the minimum peak amplitude for the transmitted pulse. Added code which attempts to fit the transmitted pulse even if there is no received signal.

**0001587: QAbrowse fails to process QAP05 without valid along-track records**

Fixed browse failure when no valid along-track QA data was available. Updated QAPCompare so the QAPFlags output file will contain the current metadata parameters.

**0001580: GLA10 and 11 eta, range delay, and lat/lon problems**

- added range limit test for cloud bs and ext profile
- corrected range limit test for aerosol bs and ext profile
- changed multiple scattering warning flag to 15 when layer is sensed but does not produce an optical depth
- set range delay and uncertainty to zero when no layers are sensed.
- corrected initialization of 4-sec lat/lon (indexed with i\_c)
- set pbl4\_ht% height parameters to GLA09 input.
- initialized range delay, uncertainty, and particle size parameters to gd\_invalid.
- moved 1-sec ground height equivalencing code to before no cloud condition early return.
- modified index of lat and lon from i\_d to i\_t.
- fixed calculation of eta.
- added out-of-range tests for eta inputs and eta
- added extra check for gd\_invalid for the d\_eta parameter.
- removed check on SPCM's enabled in order to enable 1064 layer detection for Laser 1.
- modified ground detection threshold (GD\_GDET\_FTR) from 5.0d0 to 9.0d0.



- Set GLA08%d\_LRpbl\_grd (low resolution PBL ground detection) to the the GLA09 value (cld4%d\_grd\_det) and GLA08%d\_HRpbl\_grd to the GLA09 value (GLA08%d\_HRpbl\_grd) for consistency between GLA08-09 products.
- Fixed array problems with lat/lon for GLA10 and 11.

**0001579: GYRO time offset**

Added a correction of -50ms to the GLA04 Gyro time offset. This change was made in the ANC07\_05 file.

**0001543: Geoid is incorrect in V3.9 data products**

The original V3.8 correction factor (  $18.1 + 1.3 * \{ 9.9 - 29.6 * [\sin(\text{latitude})]^2 \}$  cm) supplied by Dr. Pavlis was in error. The old factor was also subtracted from the original WGS-84 geoid height in V3.8 when it should have been added. The software used to rereference the geoid is attached. Three text files are also attached showing lat/lon/ht examples of: The original WGS-84 referenced geoid (version 1), the incorrectly repaired V3.8 file (version 4), and the corrected new version of the file (version 5). Deliv-ered version 5 Geoid file.

**0001538: Refinement of time selection in reorbit\_util**

An empirical modification to the reorbit\_util software improves the locations available for the "seam" orbit track by correcting a small timing offset. This applies to any of the repeat cycle ref-erence orbits currently being used.

**0001497: Add A Flag To WFQual**

Removed unused anc07\_04 parameter. Added minimum signal width and minimum peak to noise ratio to anc07. Added new flag to wfQual in gla05 to indicate suspect waveforms (very small sig-nal width or small max amplitude to noise ratio).

**0001464 - ANC45 updates**

Requested Parameter Name changes have been made to the ANC45 files. These changes flow into the product headers and, ultimately, the metadata files.

**0001418 - Get error running qapg after adding 8 chars to GLA file names**

QAPG code was changed to make QAPG function in the SCF environ-ment with only the GLA04 LPA file as input.

**0001397: QAP 01 Problems in Release 16**

Corrected IF tests used to update QA\_Sum%Sum\_Out%i\_num\_WfAPIDs. Corrected calculation of number of expected waveforms. Replaced code used to determine end of along-track period with call to PastEndOfPeriod

**0001317: GLAS\_Atm bombs in a\_interp\_met**

See 00001639.

**0000808 - Elevation Manager Crashes in update\_GLA06QA**

Added check for invalid data before updating histograms.

**Changed ANC07 Parameters:**

ANC07\_02

changed GD\_GDET\_FTR from 5.0 to 9.0

ANC07\_04

added D\_ABETA = 0.8

added D\_NSIGTX = 1.5d0

added D\_MINSIGWIDTH = 5.0d0

added D\_MINPK2NS = 5.0d0

ANC07\_05

changed GD\_GYRO\_TIME\_LAT from 0.001763d0 to -0.048237d0

# Abbreviations & Acronyms

A2P	Algorithm-to-Product Conversion
ALT	Altimeter or Altimetry, also designation for the EOS-Altimeter spacecraft series
ANCxx	GLAS Ancillary Data Files
APID	GLAS Level-0 Data file
ATBD	Algorithm Theoretical Basis Document
ATM	Atmosphere
CCB	Change Control Board
ClearCase	GSAS version tracking software
CR	Change Request
DAAC	Distributed Active Archive Center
DEM	Digital Elevation Model
DFD	Data Flow Diagram
DLT	Digital Linear Tape
EDOS	EOS Data and Operations System
EDS	Expedited Data Set
ELEV	Elevation
EOC	EOS Operating Center
EOS	NASA Earth Observing System Mission Program
EOSDIS	Earth Observing System Data and Information System
GB	Gigabyte
GDS	GLAS Ground Data System
GLAS	Geoscience Laser Altimeter System instrument or investigation
GLAxx	GLAS Science Data Product Files
GLOP	GLAS Level-0 PGE (correctly called GLAS_L0proc)
GPS	Global Positioning System
GSAS	GLAS Science Algorithm Software
GSFC	NASA Goddard Space Flight Center at Greenbelt, Maryland
GSFC/WFF	NASA Goddard Space Flight Center/Wallops Flight Facility at Wallops Island, Virginia

HDF	Hierarchal Data Format
HDF-EOS	EOS-specific Hierarchal Data Format
I-SIPS	Icesat Science Investigator Led Processing System
I/O	Input/Output
ICESAT	Ice, Cloud and Land Elevation Satellite
ID	Identification
IEEE	Institute for Electronics and Electrical Engineering
ISF	Instrument Support Facility
IST	Instrument Star Tracker
KB	Kilobyte
L0	Level 0
L1A	Level-1A
L1B	Level-1 B
L2	Level-2
LASER	Light Amplification by Stimulated Emission of Radiation
LIDAR	Light Detection and Ranging
LPA	Laser Pointing Array
LRS	Laser Reference System
MB	Megabyte
MET	(context sensitive) Mission Elapsed Time or Meteorological
MOSS	Mission Operations Science Simulation (test)
N/A or NA	Not (/) Applicable
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
P2A	Product-to-Algorithm Conversion
PAD	Precision Attitude Determination
PDF	Portable Document Format
PDS	Production Data Set
PGE	Product Generation Executable
POD	Precision Orbit Determination
PR	Problem Report
QA	Quality Assessment

QAP	Quality Assessment Processing
SC	Structure Chart
SCF	Science Computing Facility
SDMP	Science Data Management Plan
SDMS	Scheduling and Data Management System
SDP	Standard Data Products
SRS	Stellar Reference System
SSMP	Science Software Management Plan
SSRF	Science Software Requirements Document
TBD	to be determined, to be done, or to be developed
UNIX	the operating system jointly developed by the AT&T Bell Laboratories and the University of California-Berkeley System Division
UTC	Universal Time Correlation
WF	Waveform
A2P	Algorithm-to-Product Conversion
ALT	Altimeter or Altimetry, also designation for the EOS-Altimeter spacecraft series
ANCxx	GLAS Ancillary Data Files
APID	GLAS Level-0 Data file
ATBD	Algorithm Theoretical Basis Document



# Glossary

aggregate	A collection, assemblage, or grouping of distinct data parts together to make a whole. It is generally used to indicate the grouping of GLAS data items, arrays, elements, and EOS parameters into a data record. For example, the collection of Level 1B EOS Data Parameters gathered to form a one-second Level 1B data record. It could be used to represent groupings of various GLAS data entities such as data items aggregated as an array, data items and arrays aggregated into a GLAS Data Element, GLAS Data Elements aggregated as an EOS Data Parameter, or EOS Data Parameters aggregated into a Data Product record.
array	An ordered arrangement of homogenous data items that may either be synchronous or asynchronous. An array of data items usually implies the ability to access individual data items or members of the array by an index. An array of GLAS data items might represent the three coordinates of a georeference location, a collection of values at a rate, or a collection of values describing an altimeter waveform.
file	A collection of data stored as records and terminated by a physical or logical end-of-file (EOF) marker. The term usually applies to the collection within a storage device or storage media such as a disk file or a tape file. Loosely employed it is used to indicate a collection of GLAS data records without a standard label. For the Level 1A Data Product, the file would constitute the collection of one-second Level 1A data records generated in the SDPS working storage for a single pass.
header	A text and/or binary label or information record, record set, or block, prefacing a data record, record set, or a file. A header usually contains identifying or descriptive information, and may sometimes be embedded within a record rather than attached as a prefix.
item	Specifically, a data item. A discrete, non-decomposable unit of data, usually a single word or value in a data record, or a single value from a data array. The representation of a single GLAS data value within a data array or a GLAS Data Element.
label	The text and/or binary information records, record set, block, header, or headers prefacing a data file or linked to a data file sufficient to form a labeled data product. A standard label may imply a standard data product. A label may consist of a single header as well as multiple headers and markers depending on the defining authority.
Level 0	The level designation applied to an EOS data product that consists of raw instrument data, recorded at the original resolution, in time order, with any duplicate or redundant data packets removed.
Level 1A	The level designation applied to an EOS data product that consists of reconstructed, unprocessed Level 0 instrument data, recorded at the full resolution with time referenced data records, in time order. The data are annotated with ancillary information including radiometric and geometric calibration coefficients, and georeferencing parameter data (i.e., ephemeris data). The included, computed coefficients and parameter data have not however been applied to correct the Level 0 instrument data contents.

---

Level 1B	The level designation applied to an EOS data product that consists of Level 1A data that have been radiometrically corrected, processed from raw data into sensor data units, and have been geolocated according to applied georeferencing data.
Level 2	The level designation applied to an EOS data product that consists of derived geophysical data values, recorded at the same resolution, time order, and georeference location as the Level 1A or Level 1B data.
Level 3	The level designation applied to an EOS data product that consists of geophysical data values derived from Level 1 or Level 2 data, recorded at a temporally or spatially resampled resolution.
Level 4	The level designation applied to an EOS data product that consists of data from modeled output or resultant analysis of lower level data that are not directly derived by the GLAS instrument and supplemental sensors.
metadata	The textual information supplied as supplemental, descriptive information to a data product. It may consist of fixed or variable length records of ASCII data describing files, records, parameters, elements, items, formats, etc., that may serve as catalog, data base, keyword/value, header, or label data. This data may be parsable and searchable by some tool or utility program.
orbit	The passage of time and spacecraft travel signifying a complete journey around a celestial or terrestrial body. For GLAS and the EOS ALT-L spacecraft each orbit starts at the time when the spacecraft is on the equator traveling toward the North Pole, continues through the equator crossing as the spacecraft ground track moves toward the South Pole, and terminates when the spacecraft has reached the equator moving northward from the South Polar region.
module	A collection of program statements with four basic attributes: input and output, function, mechanics and internal data.
pass	A sub-segment of an orbit, it may consist of the ascending or descending portion of an orbit (e.g., a descending pass would consist of the ground track segment beginning with the northernmost point of travel through the following southernmost point of travel), or the segment above or below the equator; for GLAS the pass is identified as either the northern or southern hemisphere portion of the ground track on any orbit
product	Specifically, the Data Product or the EOS Data Product. This is implicitly the labeled data product or the data product as produced by software on the SDPS or SCF. A GLAS data product refers to the data file or record collection either prefaced with a product label or standard formatted data label or linked to a product label or standard formatted data label file. Loosely used, it may indicate a single pass file aggregation, or the entire set of product files contained in a data repository.
program	The smallest set of computer instructions that can be executed as a stand-alone unit
record	A specific organization or aggregate of data items. It represents the collection of EOS Data Parameters within a given time interval, such as a one-second data record. It is the first level decomposition of a product file.
Scenario	A single execution path for a process.

---



Standard Data Product	Specifically, a GLAS Standard Data Product. It represents an EOS ALT-L/ GLAS Data Product produced on the EOSDIS SDPS for GLAS data product generation or within the GLAS Science Computing Facility using EOS science community approved algorithms. It is routinely produced and is intended to be archived in the EOSDIS data repository for EOS user community-wide access and retrieval.
Subroutine	A program that is called by another program
variable	Usually a reference in a computer program to a storage location, i.e., a place to contain or hold the value of a data item.

